HANDBOOK FOR UNDERGRADUATE STUDENTS

SCHOOL OF BIOLOGY

2014 - 2015
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INTRODUCTION

The School of Biology has approximately 450 undergraduate majors, the largest enrollment of any of the schools in the College of Sciences. Biology faculty members, however, work hard to treat every student as a unique individual. Faculty and students together constitute a mutually supportive intellectual community. All biology majors are encouraged to know and to become known by their professors. The names, academic interests, and phone numbers of all faculty members are listed on the Biology website at http://www.biology.gatech.edu/people/faculty.php.

This handbook is intended for the use of undergraduate students in the School of Biology. Its purpose is to provide information supplementary to that contained in the “General Catalog” (http://www.catalog.gatech.edu/) and the “Rules and Regulations” (http://www.catalog.gatech.edu/rules/1.php) in matters that pertain specifically to the School of Biology. The School of Biology website at www.biology.gatech.edu provides an additional resource. Information for registering for classes, advisor contact information, FAQ’s, etc., can be found on the Undergraduate Program page of the Biology web page at http://www.biology.gatech.edu/undergrad/current-students. This handbook and the Biology web pages are not intended to supersede the “General Catalog” or the “Rules and Regulations.” In the case of any conflicts, these latter documents will prevail.

SCHOOL OF BIOLOGY ORGANIZATION

I. School Chair: Dr. Terry Snell, Professor, Room 201 Cherry Emerson
   The Chair of the School of Biology is Dr. Terry Snell, who is responsible for the overall operation of the School.

II. Associate Chair for Undergraduate Affairs: Dr. Michael Goodisman, CE A110
    The Associate Chair of Undergraduate Affairs works directly with the School of Biology Academic Office to ensure smooth operation of the Undergraduate Program.

III. Academic Office:
    Academic Advisors: Dr. Mirjana Brockett, 323 Cherry Emerson (M–R)
                    Dr. Linda Green, 474C Clough Commons (A–F)
                    Dr. Shana Kerr, A114 Cherry Emerson (S–Z)
                    Dr. Chrissy Spencer, 474D Clough Commons (G–L)

    Academic Program Coordinator: Ms. Benita Black, 474E Clough Commons

   The main functions of the Academic Office are to:
   1. Organize undergraduate academic activities in the School.
   2. Act as liaison to other schools and units on campus on matters relating to undergraduate education.
   3. Coordinate an active and responsive academic advising program.
   4. Provide advice and direction to students about academic programs and careers.
THE LONG-TERM GOAL: EMPLOYMENT AND EDUCATION AFTER GRADUATION

Job Placement: The most frequently asked question is “What can I do with a B.S. in Biology?” You will be pleased to learn that there are excellent employment opportunities for those trained in the life sciences with a BS degree. The School of Biology assists students in obtaining internships during their time at Tech, and the Center for Career Discovery and Development (www.careerdiscovery.gatech.edu) is also a great resource. Additional Biology resources are available on the School of Biology website at http://www.biology.gatech.edu/undergrad/career-links.

Graduate School: A degree in biology gives you flexibility to pursue diverse fields of study in graduate programs focusing on topics such as molecular biology, conservation biology, engineering, business, or education.

Professional School: Georgia Tech biology graduates are regularly accepted into schools of medicine, dentistry, optometry, pharmacy, and veterinary medicine. To find out more about these and other pre-health options, contact the Pre-Health Advising Office and the School of Biology chapter of the American Medical Student Association (AMSA) premedical society.

THE SHORT-TERM GOAL: B.S. DEGREE REQUIREMENTS

A Bachelor of Science in Biology requires a minimum of 122 credit hours. All courses must be taken for a letter grade, except for Free Electives which can include pass/fail courses. All letter grades of D and higher are accepted in the Biology degree.

Required Biology Core Courses
BIOL 1511 (or 1510) Majors/Honors Biological Principles
BIOL 1521 (or 1510) Majors/Honors Intro to Organismal Biology
BIOL 2335 (or 2337) General Ecology (or Honors)
BIOL 2344 (or 2354) Genetics (or Honors)
BIOL 3450  Cell and Molecular Biology
BIOL 3600  Intro to Evolution
BIOL 4450  Senior Seminar
Two of these three labs: Ecology Lab (BIOL 2336 or 2338), Genetics Lab (BIOL 2345 or 2355), or Cell and Molecular Biology Lab (BIOL 3451) (each lab should be taken concurrently with the associated lecture course unless otherwise noted during registration).

Required Quantitative Biology Course
One of the following:
BIOL 2400  Mathematical Models in Biology
BIOL 4150  Genomics & Applied Bioinformatics
BIOL 4401  Experimental Design & Biostatistics
Other advanced quantitative courses may be appropriate depending on your interests and strengths. If you wish to enroll in a course other than BIOL 2400, BIOL 4401, or BIOL 4150 to fulfill your quantitative requirement, you must discuss with your advisor to seek School of Biology approval.

Required Senior Research Experience
One of the following:
BIOL 4590  Research Project Lab
BIOL 4690  Independent Research Project
BIOL 4910  Honors Research Thesis
Required Non-Biology Science Courses
CHEM 1211K    Chemical Principles I
CHEM 1212K    Chemical Principles II
CHEM 2311    Organic Chem I, Principles (sections P and higher)
CHEM 2312    Organic Chem II, Principles (sections P and higher)
CHEM 2380    Synthesis Lab
MATH 1503 * (or MATH 1501)  Calculus I for Life Sciences
MATH 1504 (or MATH 1502)  Calculus II for Life Sciences
PHYS 2211    Intro Physics I (recommend “Modern” sections M, N)
PHYS 2212    Intro Physics II (recommend “Modern” sections M, N)

Biology Electives
21 credit hours selected from BIOL 3XXX level and higher courses are required. A maximum of 9 credit hours can be applied towards the 21 hours from the approved list of courses offered in other departments (see Appendix). A maximum of 6 hrs of Business Option electives can be applied to these 9 hrs. Biology Elective courses cross-listed with APPH or BMED do not deduct from these 9 credit hours. A maximum of 6 hrs of BIOL 4697 can be applied to the 21 total hrs, and a maximum of 6 hrs of BIOL 4699 can be applied to the 21 total hrs.

Humanities and Social Sciences Electives
See “Core Curriculum,” Information for Undergraduate Students on the Registrar’s website (http://www.catalog.gatech.edu/students/ugrad/core/core.php) for approved courses and caveats. All students are required to take a total of 12 hours of Social Sciences and 6 hours of Humanities, in addition to ENGL 1101* and 1102*. Three of these 18 hours must also fulfill the Global Perspectives requirement. Students may use courses from this list to fulfill both requirements (Humanities and Global, or Social Sciences and Global) at the same time.

As part of the 12 hours of Social Sciences, all students are required to take one course from HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200 to satisfy state requirements regarding United States Perspectives.

Computing Requirement
Students must complete CS 13X1 (transfer course), CS 1301, CS 1315, or CS 1371.

Wellness Requirement
Georgia Tech requires students to complete APPH 1040 (formerly HPS 1040) or APPH 1050.

Free Electives
The remaining 11 credits beyond those listed above are free electives, which can be taken for letter grade or pass/fail.

* Timing: Students must complete MATH 1503 (or 1501) and ENGL 1101 and 1102 courses within their first 30 credit hours as part of the required Communication and Quantitative Outcomes. After 30 reaching credit hours, student must enroll in the next course necessary to make progress toward completing this requirement in every semester in which they take classes.
ADVISORS

Upon your arrival at Georgia Tech or when you declare Biology as your major, you will be assigned an academic advisor. Advisor assignments are by last name as follows:

<table>
<thead>
<tr>
<th>Last names beginning</th>
<th>Advisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>A–F</td>
<td>Dr. Linda Green</td>
</tr>
<tr>
<td>G–L</td>
<td>Dr. Chrissy Spencer</td>
</tr>
<tr>
<td>M–R</td>
<td>Dr. Mirjana Brockett</td>
</tr>
<tr>
<td>S–Z</td>
<td>Dr. Shana Kerr</td>
</tr>
</tbody>
</table>

Your advisor is here to help you whenever you seek advice and to provide guidance about Georgia Tech regulations, undergraduate programs, and career opportunities. You are strongly urged to consult your advisor to plan and execute your program of study, to discuss career options, and to design an optimal map for achieving your goals. Advisors use a web-based scheduling system to arrange advising appointments (http://www.advising.gatech.edu/appointments).

Annual Advising Meeting

The Biology program recognizes that providing advising support for our undergraduates helps students succeed in effective course selection and career planning, which includes finding on-campus and summer research and internship opportunities, establishing a timeline for career planning, and exploring the range of options you have with a B.S. in Biology.

Therefore, Biology majors are required to attend an annual 15 minute advising meeting. The Annual Advising appointment is an opportunity to work one-on-one with your advisor to devise an optimal pathway to achieve your academic and career goals.

Biology majors will receive an email invitation according to academic class standing: freshmen/sophomores in the Spring and juniors/seniors in the Fall. The email will give the scheduling deadline and detail what you need to bring to your advising appointment. Seniors will review their graduation status and discuss the Online Application for Graduation at this advising session. The graduation application deadline occurs around midterm of your second-to-last semester (specific dates are posted on the registrar’s website http://www.registrar.gatech.edu/students/index.php).

Midterm Progress Reports

At midterm, you may also be contacted by your advisor to check-in regarding your academic progress. Depending upon your Midterm Progress Report grades (provided for all 1000-2000 level courses), you may be invited to communicate by email or in person with your advisor to make an academic plan for the remainder of the semester. These meetings are to be taken seriously, and failure to respond may result in a registration hold placed on your account.

DegreeWorks

Students are responsible for the success of their own academic careers. You are expected to monitor your progress towards your degree requirements using DegreeWorks (http://degreeworks.gatech.edu/), and to bring any discrepancies to the attention of your Academic Advisor. Discrepancies include missing transfer credits, courses listed in the incorrect category, or courses double-counted toward your degree. Advisors can work with Degree Certification to ensure that your courses are correctly attributed toward your degree. Should you wish to consider an alternative to Biology or a second major, the “What If” tool can be used to explore how progress towards degree completion is affected if you change or add majors.
B.S. DEGREE ENHANCEMENTS

Bachelor of Science in Biology – Research Option
This option enables students to do 9 credit hours of supervised research with a Biology Faculty member over multiple semesters. With Faculty guidance, students write a brief proposal, perform independent, original research, and write a thesis about their work. The thesis is evaluated by two Biology Faculty members. The first 6 credit hours of the research option are taken as BIOL 2699/4699 (research for credit) or BIOL 2698/4698 (research for pay). Students then take either BIOL 4690 (Independent Research Project; 3 hr) or BIOL 4910 (Honors Research Thesis; 3 hr) and two one credit-hour writing courses, LMC 4701 and 4702. These writing courses can be counted as Biology electives for students completing the Research Option. Note that LMC 4701 should be taken in the semester PRIOR to enrolling in BIOL 4910/4690. The student’s research is presented in BIOL 4450 Senior Seminar. Completing this program gives students a “Research Option” designation on their transcripts. Students can consult the Undergraduate Research Opportunities Program for more details http://urop.gatech.edu/research-option.

Bachelor of Science in Biology – Business Option
Completing the B.S. in Biology with a Business Option is a good idea for students who are interested in the business of biology, intend to manage their own clinic or practice after professional school, or who may want to pursue an M.B.A. upon graduation. Students in the biology business option must complete 15 credits of approved coursework covering the principles of accounting, economics, and management. Two electives allow students to take advanced coursework in these areas, or to explore the legal, international, entrepreneurial, technological or financial aspects of the business world. Six of the credit hours from the list of management (MGT) courses will fulfill requirements for Biology electives, and another 3 credit hours of management courses count as free electives. Additional courses within the Business Option may satisfy Social Science electives. Biology majors in this option must still fulfill the other requirements for the Biology undergraduate degree and should note that the MGT courses used as Biology electives reduce the approved Biology electives from outside Biology. Students interested in the Business Option should visit http://www.biology.gatech.edu/undergrad/business-option for specific details on the courses available.

Bachelor of Science in Biology - International Plan
Georgia Tech offers an International Plan through the Office of International Education (http://www.internationalplan.gatech.edu/). Successful completion of this plan earns students an International Plan designation on their Georgia Tech degree. The primary purpose of the plan is to offer a challenging and coherent academic program for students to develop global competence within the context of a Biology degree. The specific requirements of the International Plan can be found at https://internationalplan.gatech.edu/students/program-requirements. Georgia Tech biology courses are taught in Australia/New Zealand (http://www.pacific.gatech.edu/) and Spain (http://spainportugal2014.weebly.com/index.html) as part of the Study Abroad program. In addition, many biology courses are available through Georgia Tech partner universities abroad (http://www.oie.gatech.edu/sa/programs/index.php). Some of these universities teach biology courses in English, such as Hong Kong University, Tokyo Technological University, University of Victoria (New Zealand), National University of Singapore, University of Strathclyde (Scotland), and Bilkent University (Turkey).

REGISTRATION
During Phase 1 and Phase 2 registration, you may begin registering for classes as soon as your time-ticket opens. To confirm how your courses fit into your degree requirements, check
DegreeWorks after you register. If you have concerns about how your courses are attributed in DegreeWorks, please see your academic advisor. The B.S. Biology degree can be completed in 8 semesters if you complete around 15 hours in each semester. This will often include one or two lab courses per semester.

**Permits (Override Requests)**

For Biology courses, permits for pre-requisite, class, or major overrides should be requested from the faculty member teaching the course or through your academic advisor. Permit request forms for Biology courses are at [http://www.biology.gatech.edu/undergraduate-program/current-students/docs/bio-overload-form.pdf](http://www.biology.gatech.edu/undergraduate-program/current-students/docs/bio-overload-form.pdf). Have the professor sign the form and return it to Ms. Black in Clough 474E. For non-biology courses, look on the department's website for their registration instructions. Some departments do permits by email, while others require that a request is submitted through the registration window in OSCAR.

A prerequisite override is submitted by a student if the course instructor agrees that the student is prepared for the course without having taken the listed prerequisite courses – the instructor’s signature is required in this case. In other cases, BANNER sometimes does not recognize legitimate prerequisite courses on a student’s transcript, and may prevent them from registering for a course. A student doesn't need the instructor's signature for this problem. Submit a prerequisite override form (available at [http://www.biology.gatech.edu/undergraduate-program/current-students/docs/bio-overload-form.pdf](http://www.biology.gatech.edu/undergraduate-program/current-students/docs/bio-overload-form.pdf)) directly to Benita Black in Clough 474E. Be sure to include your contact information.

None of these requests should be made by phone. Allow 1 business day for the form to be processed.

**Waitlisting and Overloads**

Biology uses the Waitlist feature to assist our majors with course registration. The waitlist allows students who want to enroll in a full course to sign up on a virtual waitlist and sequentially offered a seat when another student drops. Because of this feature, we do not allow student to overload into our courses. If a section has no available seats, students will be able to register for the waitlist. Registering on a waitlist does not guarantee that you will receive a seat in the section. If seats become available, the system will automatically issue an email notification with permission to register to the next student on the waitlist. Notifications are only valid for a short time period (usually 12 hrs); after that time, the permission to register expires and the seat will be given to the next person on the waitlist. If you require a course in a specific semester for an on-time degree completion, you should waitlist and then contact your advisor for assistance.

The waitlist notifications will start once all time tickets are open. If a section has a waitlist, the open seats are reserved for the people on top of the waitlist. Do not drop your current section unless you want to be waitlisted. The waitlists will not be purged between registration phases, i.e. students that register on the waitlist for a section in Phase I will retain their spot on the list for Phase II. Check on the registrar's website for details of waitlist timing; typically, the last round of waitlist notifications will be issued at 5pm ET the day before registration closes. After 5pm ET, the waitlist is no longer functioning and all remaining open seats are first-come, first-serve.

During Drop/Add week (the first week of classes), we suggest that you attend all classes that are registered in or waitlisted for so that you do not fall behind. Important class material is covered during that first week.
Transfer Credit Options
Transfer confirmation is a two-step process to determine whether: 1) Georgia Tech has an equivalent approved course and 2) that the transfer credit was taken before the student’s last 36 hours at Georgia Tech.

First, confirm that a course will transfer using the transfer equivalency table on OSCAR (https://oscar.gatech.edu/pls/bprod/wssktrna_P_find_location). If the course is not listed, check with the relevant department at Georgia Tech to assess whether the course can be transferred before you take the course. For a Biology course, the course will be evaluated for transfer credit by Dr. Jung Choi (jung.choi@biology.gatech.edu). Include the name of the college, the course number and description, and the class syllabus for the evaluation of transfer credit. Transfer Biology courses may be allowed as Biology electives if the course is a 3XXX or 4XXX level course with pre-requisites and the student’s advisor and the Associate Chair for Undergraduate Affairs both agree that it has relevance to the student’s major studies.

Second, be aware that students must complete the last 36 credit hours of their degree program in residence at Georgia Tech, the “36-hour rule.” Note that Georgia Tech cross-enrollment, off-campus and exchange programs are considered “in residence” for the 36-hour rule. Exceptions to the 36-hour rule may be granted by approval of a petition to the Institute Undergraduate Curriculum Committee; however, approval of this type of petition is rare. It is recommended to petition for an exception BEFORE violating the rule. Additionally, many medical schools only accept prerequisite courses taken at four-year institutions. While students may not receive transfer credit from a course taken at another institution when concurrently enrolled at Georgia Tech, students are allowed to Cross-Enroll at other area schools through the ARCHE program. For additional information, refer to the ARCHE website at http://www.registrar.gatech.edu/registration/cross/index.php and consult with the ARCHE advisor at crossregistration@registrar.gatech.edu.

ONLINE APPLICATION FOR GRADUATION (OAG)
In the semester before you intend to graduate, students submit an Online Application for Graduation by completing the steps below. Before you begin, please take note of the following instructions and deadlines. If the Business Option will be a component of the B.S. Biology degree, this is indicated through Oscar (www.degreeworks.gatech.edu/images/training/concentration_mgt.pdf).

Instructions for the Online Application for Graduation (OAG)
1. Log into degreeworks.gatech.edu and confirm that your courses are listed correctly under each Biology degree requirement. (For example, CHEM 1310 should fulfill Core Area D: General Chemistry, not a Free Elective or a Fallthrough Course.)
   a. Take careful note of the courses that you still lack to complete your degree. You must enroll in these courses in your final semester to complete your degree requirements.
   b. If you see inconsistencies, email your advisor or schedule an appointment to clear up the errors. Once all errors are resolved, THEN proceed with step 2.
2. During the application window (see below), login to OSCAR and select: Student Services>Student Records>Apply to Graduate.
3. Confirm that your curriculum is listed as a B.S. in Biology. If you are completing a minor or an option, that must be listed as well. If your curriculum is incorrect, stop immediately and contact Degree Certification (dc@lists.gatech.edu or 404-894-4150) for assistance.
4. Select the radio button for your program. (If you have more than one major, you’ll have to select one at a time and repeat the entire process for your second major.)
5. Select the graduation term in the drop down that will appear.
6. On the next screen, request any changes to your first or middle names to appear on your diploma. Please note that all requests will be reviewed by the Office of the Registrar and are subject to approval. If you would like to change your last name or make more significant changes to your diploma name, please contact the Office of the Registrar.
7. Confirm the address you would like to use as your diploma mailing address.
8. Review the summary of your application before clicking on “Submit Request.”
9. At the confirmation screen, you will be redirected to an Exit Survey sponsored by the Office of Assessment. Please continue with the Exit Survey to complete your application.
10. Once you have applied, you will be able to view your Application and Graduation status in DegreeWorks near the top of your degree audit, under the section entitled “Student View.” Upon applying you will be given an Application Status of “Active” and a Graduation Status of “Received, Pending Evaluation.” You can continue to check your status throughout the semester, and work with your advisor to resolve any deficiencies in a timely manner.
# BACHELOR OF SCIENCE IN BIOLOGY 2014-2015 DEGREE REQUIREMENTS

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<thead>
<tr>
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<th>HOURS</th>
<th>FIRST YEAR - SPRING</th>
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<td>BIOL 1521 (OR 1520) INTRODUCTION TO ORGANISMAL BIOLOGY¹</td>
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<td>CHEM 2312 ORGANIC CHEMISTRY II</td>
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<td>CHEM 2380 SYNTHESIS LAB</td>
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<td>FREE ELECTIVE or QUANTITATIVE BIOLOGY REQUIREMENT³</td>
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<td>COMPUTING REQUIREMENT</td>
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<td>GLOBAL PERSPECTIVE (HUM or SS)</td>
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<td>QUANTITATIVE BIOLOGY REQUIREMENT³ or FREE ELECTIVE</td>
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<td><strong>TOTAL SEMESTER HOURS</strong></td>
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<td>BIOL 3451 CELL &amp; MOLECULAR BIOLOGY LAB</td>
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<td>WELLNESS</td>
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<td>15 or 16</td>
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<tr>
<td><strong>TOTAL SEMESTER HOURS</strong></td>
<td>16</td>
<td><strong>TOTAL SEMESTER HOURS</strong></td>
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<td>BIOLOGY ELECTIVE</td>
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<td>FREE ELECTIVE</td>
<td>3</td>
</tr>
<tr>
<td>FREE ELECTIVE</td>
<td>3</td>
<td>HUM or SS ELECTIVES</td>
<td>6</td>
</tr>
<tr>
<td>HUM or SS ELECTIVE</td>
<td>3</td>
<td>FREE ELECTIVE</td>
<td>3</td>
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<tr>
<td>BIOL 4450 SENIOR SEMINAR</td>
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<td><strong>TOTAL SEMESTER HOURS</strong></td>
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<tr>
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<td><strong>TOTAL SEMESTER HOURS</strong></td>
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</tr>
</tbody>
</table>

**TOTAL DEGREE REQUIREMENT HOURS** 122

*Not required for graduation, another free elective may be substituted
Important notes

1. 4 credit hours of Biology elective may be substituted for BIOL 1520 if a score of 5 was achieved on the AP Biology test. A maximum of 1 of these credits may be BIOL 4697 or BIOL 4699. Please discuss this option with your advisor. It is important to note that substituting BIOL 1520 often results in a student needing to take more than a single Biology elective class, because most Biology electives are only 3 credit hours.

2. Only 2 of the following 3 core labs are required: BIOL 2336/2338, BIOL 2345/2355, BIOL 3451

3. Quantitative Biology Requirement: choose one of the following: BIOL 2400 Mathematical Models in Biology, BIOL 4150 Genomics & Applied Bioinformatics, BIOL 4401 Experimental Design & Biostatistics

4. Senior Research Experience: choose one of the following: BIOL 4590 Research Project Lab, BIOL 4690 Independent Research Project, BIOL 4910 Honors Research Thesis. Senior Research Experience can be fulfilled in either fourth-year fall or spring semester.

BIOLOGY MINOR

A minor in biology is available to all non-biology majors. The minor is awarded by the registrar's office and appears on your transcript and diploma. The minor constitutes 15 credit hours of Biology (BIOL) courses, of which 9 hours must be at the 3000 level or higher and of which 3 hours can be Biology Special Topics courses and 3 hours can be BIOL 4699. Any section of a cross-listed Biology elective, such as APPH Anatomy and Physiology lecture and lab courses, can be used toward the Biology minor. All courses counting toward the minor must be taken on a letter-grade basis and completed with an overall grade point average of at least 2.00. Students may not double-count courses towards more than one certificate or minor. A course may double-count towards the student's major and minor if the course:

1. Is not required or listed by name and number for their major
2. Is not fulfilling a core area humanities or social sciences (A-E)

Free electives and technical electives may be used towards minors. Further information is available from School of Biology advisors. To declare a minor in Biology, follow the instructions on the registrar's site: http://www.registrar.gatech.edu/students/formlanding/changeminor.php

BIOLOGY CERTIFICATES

Certificate programs in Biology are available to students from any major, including Biology. Certificates are awarded by the School of Biology and do not appear on the transcript or diploma. Each certificate requires 12 credit hours of approved courses from that certificate's list, at least 9 of which must be at the 3000 level or higher. All courses counting toward the certificate must be taken on a letter-grade basis. Major electives can be counted toward certificates, but courses required by name and number in a student’s major program of study will not be counted toward certificates. While students may complete more than one certificate, they may not double-count courses towards more than one certificate or minor.

Certificates for Non-Biology Majors
For non-majors, additional courses that can count towards any of the certificates are: BIOL 1510/1511, BIOL 1520/1521, BIOL 2335/2337, BIOL 2344/2345, BIOL 3450 as long as these courses are not required for their major program of study, with the restrictions that

1) only up to 3 credits of courses at the 1xxx-2xxx level can be used
2) at least 9 credits of BIOL coursework are required for each certificate. Any section of a cross-listed Biology elective, such as APPH Anatomy and Physiology lecture and lab courses, can be attributed as Biology courses toward the Biology certificates for non-majors.

Further information is available from School of Biology advisors.

To declare a certificate in Biology, select 12 credits that correspond to the desired certificate from the list of approved courses at http://www.biology.gatech.edu/undergraduate-program/current-students/minor.php. Two weeks prior to the end of your final semester, complete and submit the certificate application form at http://www.biology.gatech.edu/undergraduate-program/current-students/docs/Biology_Certificate_Application.doc

Certificates offered through the School of Biology

1) Biomedical Science
APPH/BIOL 3751 Human Anatomy and Physiology
APPH/BIOL 3753 Anatomy
APPH/BIOL 3754 Anatomy Lab
APPH/BIOL 3755 Human Physiology
APPH/BIOL 3756 Physiology Lab
BIOL 4015 Cancer Bio/Tech
BIOL 4105 Macromolecular Modeling
BIOL 4150 Genomics & Applied Bioinformatics
BIOL 4340 Medical Microbiology
BIOL 4401 Experimental Design and Statistical Methods
BIOL 4464 Developmental Biology
BIOL 4480 Evolutionary Developmental Biology
BIOL 4545 Human Genetics
BIOL 4570 Immunology and Immunochemistry
BIOL 4608 Prokaryotic Molecular Genetics
BIOL 4650 Bioethics
BIOL 4668 Eukaryotic Molecular Genetics
BIOL 4752 Introduction to Neuroscience
BIOL 4802 Special Topics: Biomedical Entrepreneurship in the Life Sciences
BIOL 4802 Special Topics: Drug Discovery
BIOL 4803 Special Topics: Virology
BIOL 4803 Special Topics: Endocrinology
BMED 3100 Systems Physiology
BMED 3110 Quant Engr Physio Lab I
BMED 4400 Neuroengineering
BMED 4500 Cell and Tissue Engineering Lab
BMED 4570 Diagnostic Imaging Physics
BMED/CHEM/CHBE 4765 Drug design, development and delivery
LCC 2300 Intro Biomedicine & Culture
LCC 3318 Biomedicine & Culture
PSYC 3020 Biopsychology

2) Biomolecular Technology
BIOL 3380 Microbiology
BIOL 3381 Microbiology Lab
BIOL 4012 Protein Biology
BIOL 4105 Macromolecular Modeling
BIOL 4150  Genomics
BIOL 4225  Molecular Evolution
BIOL 4440  Plant Physiology
BIOL 4746  Signaling Molecules
BIOL 4478  Biophysics
BIOL 4608  Prokaryotic Molecular Genetics
BIOL 4668  Eukaryotic Molecular Genetics
BIOL 4802  Special Topics: Drug Discovery
BIOL 4803  Regulatory RNAs
BIOL 4803  Environmental Microbial Genomics
BMED/ CHEM/ CHBE 4765  Drug design, development and delivery
CHEM 4511  Biochemistry I
CHEM 4512  Biochemistry II
CHEM 4521  Biophysical Chemistry
CHEM 4803  Special Topics: Macromolecular Structure
CHBE 4760  Biocatalysis

3) Computational & Quantitative Biology
BIOL 2400  Mathematical Models in Biology
BIOL 4105  Macromolecular Modeling
BIOL 4150  Genomics
BIOL 4225  Molecular Evolution
BIOL 4401  Experimental Design and Statistical Methods
BIOL 4422  Theoretical Ecology
BIOL 4755  Mathematical Biology
BMED 4477  Bio Networks & Genomics
BIOL 4803  Computational Systems Biology
CS 4400  Introduction to Database Systems
CS 4710  Intro to Computing Concepts in Bioinformatics
MATH 3012  Applied Combinatorics
MATH 3215  Probability & Statistics
MATH 4022  Introduction to Graph Theory
CEE/ISYE/MATH 3770  Statistics & Applications

4) Environmental Science
BIOL 2100  Biogeography of New Zealand
BIOL 3100  Ecology and Evolution of Australia
BIOL 3300  Tropical Ecology
BIOL 3380  Introductory Microbiology
BIOL 3381  Introductory Microbiology Lab
BIOL 4101  Sensory Ecology
BIOL 4221  Biological Oceanography
BIOL 4410  Microbial Ecology
BIOL 4417  Marine Ecology
BIOL 4418  Microbial Physiology
BIOL 4422  Theoretical Ecology
BIOL 4440  Plant Physiology
BIOL 4446  Animal Physiology
BIOL 4471  Behavior Biology
BIOL 4620  Aquatic Chemical Ecology
BIOL 4802  Special Topics: Community Ecology
BIOL 4803  Special Topics: Population Biology
BIOL 4803  Special Topics: Environmental Microbial Genomics
BIOL 4803  Special Topics: Urban Ecology
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>CEE 2300</td>
<td>Environmental Engineering Principles</td>
</tr>
<tr>
<td>CEE 3340</td>
<td>Environmental Engineering Laboratory</td>
</tr>
<tr>
<td>CEE 4300</td>
<td>Environmental Engineering Systems</td>
</tr>
<tr>
<td>CEE 4620</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>CHEM/EAS 4740</td>
<td>Atmospheric Chemistry</td>
</tr>
<tr>
<td>EAS 1600</td>
<td>Intro Environmental Science</td>
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<tr>
<td>EAS 1601</td>
<td>Habitable Planet</td>
</tr>
<tr>
<td>EAS 2420</td>
<td>Environmental Measures</td>
</tr>
<tr>
<td>EAS 2600</td>
<td>Earth Processes</td>
</tr>
<tr>
<td>EAS 2602</td>
<td>Earth Through Time</td>
</tr>
<tr>
<td>EAS 4110</td>
<td>Resources, Energy &amp; the Environment</td>
</tr>
<tr>
<td>EAS 4300</td>
<td>Oceanography</td>
</tr>
<tr>
<td>EAS 4350</td>
<td>Paleoclimate &amp; Paleoceanography</td>
</tr>
<tr>
<td>EAS 4410</td>
<td>Climate &amp; Global Change</td>
</tr>
<tr>
<td>EAS 4602</td>
<td>Biogeochemical Cycles</td>
</tr>
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</table>

5) Marine Science

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>BIOL 4221</td>
<td>Biological Oceanography</td>
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<tr>
<td>BIOL 4410</td>
<td>Microbial Ecology</td>
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<tr>
<td>BIOL 4417</td>
<td>Marine Ecology</td>
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<tr>
<td>BIOL 4446</td>
<td>Animal Physiology</td>
</tr>
<tr>
<td>BIOL 4620</td>
<td>Aquatic Chemical Ecology</td>
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<tr>
<td>CEE 3040</td>
<td>Fluid Mechanics</td>
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<tr>
<td>CEE 4225</td>
<td>Coastal Engineering</td>
</tr>
<tr>
<td>EAS 3620</td>
<td>Geochemistry</td>
</tr>
<tr>
<td>EAS 4300</td>
<td>Oceanography</td>
</tr>
<tr>
<td>EAS 4350</td>
<td>Paleoclimatology and Paleoceanography</td>
</tr>
<tr>
<td>EAS 4602</td>
<td>Biogeochemical cycles</td>
</tr>
<tr>
<td>NS 2323</td>
<td>Navigation</td>
</tr>
</tbody>
</table>

6) Biologically Inspired Design

All students must take BIOL/ISyE/MSE/ME 4740-Bio-Inspired Design. In addition, students will take an additional 9 credit hours of courses selected from the following list.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPH/BIOL 3753</td>
<td>Anatomy</td>
</tr>
<tr>
<td>APPH/BIOL 3755</td>
<td>Human Physiology</td>
</tr>
<tr>
<td>BIOL 4440</td>
<td>Plant Physiology</td>
</tr>
<tr>
<td>BIOL 4464</td>
<td>Developmental Biology</td>
</tr>
<tr>
<td>BIOL 4478</td>
<td>Biophysics</td>
</tr>
<tr>
<td>BIOL 4101</td>
<td>Sensory Ecology</td>
</tr>
<tr>
<td>BIOL 4446</td>
<td>Animal Physiology</td>
</tr>
<tr>
<td>BIOL 4471</td>
<td>Behavior Biology</td>
</tr>
<tr>
<td>BIOL 4752</td>
<td>Introduction to Neuroscience</td>
</tr>
<tr>
<td>BIOL 4803</td>
<td>Special Topics: Urban Ecology</td>
</tr>
<tr>
<td>BIOL 4803</td>
<td>Special Topics: Vertebrate Biology</td>
</tr>
<tr>
<td>BIO/MSE 4802</td>
<td>Special Topics: Bioinspired materials design</td>
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<tr>
<td>ARCH 4411</td>
<td>Special Topics: Bioinspired materials design</td>
</tr>
<tr>
<td>BMED 3100</td>
<td>Systems Physiology</td>
</tr>
<tr>
<td>BMED 3110</td>
<td>Quant Engr Physio Lab</td>
</tr>
<tr>
<td>BMED 4400</td>
<td>Neuroengineering Fund</td>
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<tr>
<td>BMED 4500</td>
<td>Cell and Tissue Engineering Lab</td>
</tr>
<tr>
<td>BMED 4752</td>
<td>Introduction to Neuroscience</td>
</tr>
<tr>
<td>AE/CHE/ME/BMED 4757</td>
<td>Biofluid Mechanics</td>
</tr>
<tr>
<td>AE/CHE/ME/BMED 4758</td>
<td>Biosolid Mechanics</td>
</tr>
</tbody>
</table>
7) Integrative Biology
12 credits chosen from courses represented in at least four of the other certificates (e.g., 3 credits from each of 4 other certificates = 12 credits total).

COMMON MINORS AND NON-BIOLOGY CERTIFICATES FOR BIOLOGY MAJORS

Biology undergraduates can partake in several non-biology minors that help expand the scope of the B.S in Biology undergraduate degree. The most common minors are:

Biomedical engineering – http://acad.bme.gatech.edu/undergraduate/program_ugrad_minor.php
Chemistry – http://www.chemistry.gatech.edu/undergraduate/curriculum/
Leadership Studies – http://leadership.gatech.edu/plugins/content/index.php?id=71
Management – http://mgt.gatech.edu/programs/under/
Psychology – http://www.psychology.gatech.edu/undergraduate/undergraduateprograms/certificates.php

UNIVERSITY RESOURCES

Tutoring: Georgia Tech offers many excellent opportunities to seek help in your courses. The Center for Academic Success on the second floor of Clough Commons offers 1-to-1 tutoring in most subjects as well as hosting Commons Tutoring for Chemistry, Computer Science, Math, and Physics. OMED, LAP, and the CommLab also have links from their website at http://www.success.gatech.edu/tutoring. Many of these programs keep late hours and operate in convenient locations, such as the Freshman Residence Halls and the Chapin Building (OMED).

Counseling Center: At some point you may encounter a challenge in academics, in your personal/social life, or involving a career choice. If it would help to have a professional counselor to whom you can talk, you can contact the Counseling Center about your concerns. Their services are described on the website: http://www.counseling.gatech.edu/. Many of their services are free to students, including individual and group consultations.

Career Planning: Georgia Tech’s Career Services provide the following resources and programs to help students explore, select and pursue a meaningful career: career counseling, majors fair, seminars, resume & job search assistance, practice interviews, a career library, and coordination with campus recruiting. You can find more information at http://www.career.gatech.edu/.

ADAPTS: The ADAPTS program serves any Georgia Tech student who has a documented, qualifying disability. Staff members in the ADAPTS Office serve as full-time advocates for students with disabilities, and they can assist in the process to document a disability. Their role is to ensure that all students have physical and programmatic access to all college programs, thereby enhancing their interactions in all activities of the campus community. See http://www.adapts.gatech.edu/ for more information.
THE INSTITUTE’S COOPERATIVE AND INTERNSHIP PROGRAMS

Cooperative Education, or "Co-op," is a unique partnership among employers, students and the university whereby students work in paid, planned and supervised work experiences in business, industry, education, and government while earning academic credit. Georgia Tech’s Cooperative Education Program (http://www.coop.gatech.edu) is a five-year academic program in which students alternate semesters as a full-time student with semesters of full-time work. In addition to providing experiences outside of academia, the Co-op program can provide the student with full-time research work within a Georgia Tech faculty member’s lab if the faculty member is agreeable.

Biology majors participating in the Co-op program must plan course schedules very carefully, since courses required for a degree in Biology may not always be offered during the at-school semester. This will be more of a problem when the at-school semester occurs during the summer semester.

The Undergraduate Professional Internship (UPI) Program (http://www.gtip.gatech.edu/) provides practical work experience in a professional setting, on-campus or off-campus, related to the student’s field of study. Internships are a partnership among students, employers, and the Georgia Institute of Technology. Internships are single-semester, paid, major-related work experiences designed to help students understand the “real world” applications of their academic studies. Opportunities are available during summer, fall, and spring semesters and require a commitment of full-time employment for a minimum of 18 weeks during the spring and fall semesters or 12 weeks during the summer semester. To contact the UPI office, email intern@dopp.gatech.edu.

THE SCHOOL OF BIOLOGY’S INTERNSHIP PROGRAM

The School of Biology has initiated an internship program specifically for Biology majors. In 2014-2015, approximately ten internship positions are available for current Biology undergraduates. These opportunities are with local government, academia, and industry groups and will provide each intern with direct, hands-on experience in how a Biology degree can be used to obtain employment upon graduation. Current partnerships exist with VWR, Inc., Caprico BioTechnologies, the CDC, Georgia Tech’s Environmental Health and Safety, the Army Defense Forensic Science Center, and GTRI Occupational Safety and Health Programs. Students can apply through the Biology Advising Tsquare site, and new opportunities will be posted as they become available. For questions about the internship positions, contact Dr. Linda Green (linda.green@biology.gatech.edu).

AWARDS IN THE SCHOOL OF BIOLOGY

Every spring semester, the faculty gives several undergraduate awards in Biology. These awards are presented to students demonstrating excellent academic achievement, initiative, and/or service. Some of the awards were designated by donors for students entering specific areas of study. Electronic nominations for awards will be solicited by Biology faculty and students will also be invited to self-nominate in the spring semester.

Biology Faculty Award: An award to a senior majoring in Biology who has demonstrated outstanding scholastic achievement, meritorious character, and significant contributions to the School. The award consists of a check for $500 and the student’s name engraved on a plaque permanently displayed in the School of Biology office.
Williams-Walls Award: An award to senior female biology or psychology majors who have a grade point average of 3.5 or higher and who have applied to graduate school for advanced education. The award honors the memory of Frederick Alton Williams, father of the founder of Applied Biology, Inc. The award consists of a check for $500 and the student's name engraved on a plaque permanently displayed in the School of Biology office.

Cherry L. Emerson Research Award: This award is given annually to a junior or senior in the School of Biology in recognition of a significant contribution to science through their undergraduate research. To apply for the award, the student must submit a research manuscript in the format of the journal to which it is likely to be submitted (or has already been submitted/published) to the School of Biology and a detailed letter of support from the research mentor. The award consists of $500, a personal plaque, and the student’s name on a plaque permanently displayed in the School of Biology office. This award is named in honor of two members of the Emerson legacy at Georgia Tech: Cherry L. Emerson, Sr. and Cherry L. Emerson, Jr.

John H. Ridley Award: An award to a junior in the School of Biology who plans to apply to medical or dental school, and who has demonstrated outstanding scholastic achievement and interest in research. The award consists of a check for $600 and is intended to support the recipient’s academic and research interests in the senior year.

Virginia C. and Herschel V. Clanton, Jr. Scholarship: A financial aid award to a junior in the Schools of Biology or Chemistry who plans to apply to medical school and who has demonstrated outstanding academic achievement, interest in research, and qualifies for financial aid. The award consists of a check for $600 and is intended to support the recipient’s academic and research activities in the senior year.

ACTIVITIES IN THE SCHOOL OF BIOLOGY

Biology undergraduates engage in several extracurricular clubs and activities. More information can be found at http://www.biology.gatech.edu/undergraduate-program/current-students/clubs/

Biology Student Advisory Committee (BSAC): BSAC (http://www.biology.gatech.edu/undergraduate-program/bsac/) is a student organization open to any biology major. The purpose of this organization is to provide student recommendations on curriculum, advising or any other issue relevant to undergraduate students to the School of Biology administration. BSAC also facilitates student-faculty interaction by co-sponsoring yearly picnics and poster sessions. Faculty Advisor: Dr. Linda Green (linda.green@biology.gatech.edu).

Beta Beta Beta (Tri-Beta): Tri-Beta (http://jacketpages.gatech.edu/organizations/view/28026), the national biology honor society, is dedicated to improving the understanding and appreciation of biological study and extending human knowledge through scientific research. Full membership is restricted to students with a GPA of at least 3.0 in their biology courses and completion of at least one biology course beyond introductory biology. Associate membership is available to all students. Members enjoy a variety of activities including social gatherings and field trips, as well as the national quarterly newsletter. National once-in-a-lifetime membership dues are $45 and $35 (full and associate membership, respectively), in addition to local dues of $10 per year. Faculty Advisor: Dr. Jeannette Yen (jeannette.yen@biology.gatech.edu).

American Medical Student Association (AMSA): AMSA is a student-governed organization committed to the concerns of students who hope to become physicians. AMSA has a national membership of about 28,000, composed of premedical and medical students, interns and
American Society for Microbiology (ASM) Georgia Tech chapter: The GA Tech ASM chapter (http://www.asm.gtorg.gatech.edu/) is a student group promoting the field of microbiology as both a study and a career. The group fosters interaction between students and faculty interested in microbiology, awareness of career opportunities in microbiology, and intellectual curiosity related to the field. Sponsored Meetings and events occur monthly. Past events include visits by guest microbiologists from Georgia Tech, the CDC, and Emory; screening of movie related to microbiology; “Microbiology Jeopardy” night; and outreach opportunities at local K-12 institutions. Students also have opportunities to attend regional and national ASM meetings. Faculty Advisor: Dr. Brian Hammer (brian.hammer@biology.gatech.edu).

Pre-Veterinary Medical Association (PVMA): The PVMA (http://jacketpages.gatech.edu/organizations/view/28293) is open to students interested in pursuing a career in veterinary medicine. The PVMA provides a network of academic and professional support, as well as a fun environment to connect with fellow students interested in similar goals. We host speakers from admissions boards of Veterinary schools, tour the Georgia Aquarium and Zoo Atlanta (behind the scenes), as well as put on fundraisers and bake sales for local animal shelters. Faculty Advisor: Dr. Chrissy Spencer (chrissy.spencer@biology.gatech.edu).

Society for BioDiversity (SBD): The Society for BioDiversity (http://jacketpages.gatech.edu/organizations/view/44746) promotes the academic and professional development of students from social, cultural, or racial groups underrepresented in the sciences. While the society is geared towards the development of students from underrepresented groups, it is open to all students. Faculty Advisors: Dr. Shana Kerr (shana.kerr@biology.gatech.edu) and Dr. Yuhong Fan (yuhong.fan@biology.gatech.edu).

UNDERGRADUATE TEACHING IN THE SCHOOL OF BIOLOGY

The School of Biology offers positions for part-time work as laboratory or lecture teaching assistants in the fall and spring semesters. These positions have several requirements and are competitive. Applicants should have already taken at Georgia Tech the course they will teach and received an A or B, they must be at ease in front of a class, and they must submit an application for the position. A student will enroll in two teaching preparatory courses, BIOL 4697 and CETL 2000 BIO, in their first semester as a teaching assistant. BIOL 4697 counts as a biology elective. Upon completing these courses, an experienced undergraduate TA can apply for paid teaching assistant positions when they are available. Students may use a maximum of 6 credit of BIOL 4697 as their biology technical electives. Each semester of teaching corresponds to a different course assignment. For more information, please contact Dr. Linda Green (linda.green@biology.gatech.edu).

UNDERGRADUATE RESEARCH IN THE SCHOOL OF BIOLOGY

Research in the School of Biology is integrative, but with three general areas of focus: ecology, evolution, and behavior (http://www.biology.gatech.edu/research/ecology-evolution/); molecular and cell biology (http://www.biology.gatech.edu/research/molecular-cell/); and computational...
biology and bioinformatics (http://www.biology.gatech.edu/research/bioinformatics/).
Research is the most fulfilling scientific experience for many undergraduates and it increases
career options after graduation. Working independently on your own research project teaches
you the true nature of scientific investigation. You will learn scientific approaches, fundamental
techniques, and how to work effectively in a research environment. Undergraduate research
also provides you with experiences that make your résumé stand out. See
http://www.biology.gatech.edu/undergraduate-program and the information below for details.

Research for credit: Students can receive course credit for conducting research. Freshmen
and sophomores register for BIOL 2699. BIOL 2699 credits can count as free electives.
Juniors and seniors not taking part in their Senior Research Experience register for BIOL 4699.
Up to 6 credits of BIOL 4699 can count as Biology electives. Additional BIOL 4699 credits count
as free electives. A student needs to be offered a position by a faculty mentor to register for
research. The faculty mentor then provides permission for a student to register for one of these
research classes by emailing Ms. Benita Black (include student name, GT ID, and course
number). Each credit hour registered corresponds to approximately 3 hours per week of
research effort for a semester. During Registration, default credit for BIOL 2699/4699 is set at 1
credit hour. In Oscar, select "change course basis" to change credit hours to 3 or to an alternate
number of credits mutually agreed upon by the faculty member and student.

Seniors (or rising seniors) can complete their Senior Research Experience by registering for
BIOL 4690 or 4910 in a subsequent semester to BIOL 2699/4699.

Research for pay: Students can be paid to conduct research-related activities. After the
faculty member and student agree to the terms, the student should visit the Biology finance
office to complete appropriate paperwork to get paid. The student will then be responsible for
completing bi-weekly timesheets that the faculty mentor signs. If a student is hired at the start
of a semester, the student should register for BIOL 2698 if a freshman or sophomore, or 4698 if
a junior or senior. The faculty mentor must provide permission for a student to register by
emailing Ms. Benita Black (include student name, GT ID, and course number). BIOL 2698 and
BIOL 4698 are non-credit, audit-only courses taken at no tuition charge. Students doing
research off-campus during the summer may still register for BIOL 2698 or 4698.

Research as a volunteer: Students may volunteer to conduct research-related activities. The
arrangements are informal and the work can be negotiated between the advisor and the
student. The faculty mentor should have the student fill out the Georgia Tech Agreement for
Volunteer Services form available from the Biology office to officially recognize the volunteer
relationship.

Research for credit or pay outside of the School of Biology: Students may be able to
receive Biology research credit if they conduct research on a research project that has a
biological focus in other Schools within Georgia Tech or even in institutions outside of Georgia
Tech. If approved, the student can register for the appropriate course given the student’s
circumstances: BIOL 2698, 2699, 4690, 4698, or 4699. BIOL 4910 can only be taken with a
School of Biology faculty member who holds a major or minor, but not courtesy-only,
appointment in Biology. For research outside of the School of Biology, the student will need to
have an official co-supervisor within Biology who will serve as the instructor of record (and
second reader in the case of BIOL 4690). See Dr. Jung Choi (jung.choi@biology.gatech.edu) for
details. Note that a co-supervisor is not needed if the faculty mentor has a minor or courtesy
appointment within the School of Biology.

Prior to seeking approval from the School of Biology, the student should first get approval from
the primary research faculty mentor (e.g. in Psychology, Emory University). The research
mentor needs to be a PhD or MD level scientist, preferably in a group leader-like role. To obtain approval for this research to count for BIOL course credit, the student must then provide the Biology co-supervisor a description of the research they will be doing, the name of the primary research mentor, and the department or institution of the research mentor. The student should arrange to have a confirmation email sent from the primary research mentor, acknowledging that he/she is willing to serve as a research mentor, adhere to the Biology syllabus for the applicable research course, and provide the course grade to the Biology co-supervisor.

**Senior Research Experience:** All Biology majors need to complete a “Senior Research Experience” consisting of one of the following courses: BIOL 4590, 4690, or 4910 [http://www.biology.gatech.edu/undergraduate-program/current-students/advising/seniorresearchexperience.php](http://www.biology.gatech.edu/undergraduate-program/current-students/advising/seniorresearchexperience.php). BIOL 4690 and 4910 are conducted under the supervision of a faculty member in the research laboratory following one or more semesters of research as BIOL 2698/2699/4698/4699. Alternatively, BIOL 4590 is taught by Biology faculty members each semester in various areas of Biology. All three courses expect that students produce written documentation of a unique research project undertaken by the student. The syllabi for the courses are available from the School of Biology website. In addition, the student must take BIOL 4450 the same semester as, or the semester after, taking BIOL 4590, 4690, or 4910. Note that if 4450 is taken after BIOL 4590, 4690, or 4910, it will require a permit to register.

**The Research Option:** With faculty guidance, students write a brief proposal, perform independent and original research, and write a thesis about their work [http://www.biology.gatech.edu/undergraduate-program/current-students/advising/researchoption.php](http://www.biology.gatech.edu/undergraduate-program/current-students/advising/researchoption.php) and [http://www.undergradresearch.gatech.edu/research_option/](http://www.undergradresearch.gatech.edu/research_option/). This plan requires students to conduct 9 credit hours of supervised research over multiple semesters. The first 6 credit hours are taken by any combination of BIOL 2698, 2699, 4698, or 4699. Students then take either BIOL 4690 or 4910 in their final semester of research. BIOL 4910 is the Honors thesis option and students must have a GPA of 3.0 to sign up for BIOL 4910. All research option students must also take two one credit-hour writing courses, LCC 4701 and LCC 4702. These writing courses can be counted as Biology electives. Note that the student should take LCC 4701 and LCC 4702 in the semester prior to and during the semester they are enrolled in BIOL 4690 or 4910, respectively. For example, a student might take 3 credits of BIOL 4699 in SP12, 3 credits of BIOL 4698 and LCC 4701 in FA12, and then BIOL 4910 and LCC 4702 in SP13. Completing the Research Option gives students a “Research Option” designation on their transcripts. The Research Intent Form must be filed out by the student with the UROP office.

**President’s Undergraduate Research Awards (PURA):** The Undergraduate Research Opportunities Program funds undergraduate research [http://www.undergradresearch.gatech.edu/funding/pura/](http://www.undergradresearch.gatech.edu/funding/pura/). The awards can be made for student salaries, travel expenses, or supplies. Students must also be registered for BIOL 2698, 2699, 4698, 4699, 4910 when they have a PURA.

**Summary of Biology Research Courses:** Syllabi are available at [http://www.biology.gatech.edu/undergraduate-program/current-students/syllabi/](http://www.biology.gatech.edu/undergraduate-program/current-students/syllabi/).

BIOL 2698 – Research Assistantship: Independent research conducted under the guidance of a faculty member. 1-12 credit hours. Audit-only class, does not incur tuition charges.

BIOL 2699 – Undergraduate Research: Independent research conducted under the guidance of a faculty member. 1-12 credit hours. Grade given directly by faculty mentor.

BIOL 4450 – Senior Seminar: Senior students present seminars on recent research topics based on their own research experience and/or literature research. 1 credit hour. Biol
4590, 4690 or 4910 are prerequisites with concurrency - one of these courses must be taken before or in the same term as Biol 4450. Grade given by faculty teaching the class.

BIOL 4590 – Research Project Lab: Experience in designing, implementing, and communicating a biology research project, and practical training in modern approaches for biological research. 3 credit hours. Prerequisites: BIOL 1510. Grade given directly by faculty teaching the class.

BIOL 4690 – Independent Research Project: Independent research with proposal and manuscript writing, conducted with the guidance of a faculty member. 3 credit hours. Prerequisites: 1 credit hour of BIOL 2698 or 2699 or 4698 or 4699. Faculty may accept a student without the 1 credit hour prerequisite at their discretion by signing a prerequisite override form for the student. Students must complete the “Independent Research Project” form available from the website, and deliver this form to the instructor of record for BIOL 4690 to receive a permit. Letter grade is sent by the faculty mentor to the instructor of record of BIOL 4690.

BIOL 4698 – Research Assistantship: Independent research conducted under the guidance of a faculty member. 1-12 credit hours. Audit-only course, does not incur tuition charges.

BIOL 4699 – Undergraduate Research: Independent research conducted under the guidance of a faculty member. 1-12 credit hours. Grade given directly by research advisor.

BIOL 4910 – Honors Research Thesis: Writing and submission of a proposal and manuscript (thesis) describing independent research with a biology faculty member. Prerequisites: Students must have a GPA > 3.0 and have taken 1 credit hour of BIOL 2698 or 2699 or 4698 or 4699. Faculty may accept a student without the 1 credit hour prerequisite at their discretion by signing a prerequisite override form for the student. Students must get permission to register for BIOL 4910. Letter grade is sent by the faculty mentor to the instructor of record of BIOL 4910 for the semester in question.

The following are some suggestions for getting involved in research.

1) Earn good grades and make yourself known to your professors. Undergraduate research is competitive and you are more likely to be accepted with the faculty member of your choice if you have a strong record of academic excellence.

2) Choose an area of biology that you find interesting and corresponds to one of the areas of faculty expertise here at Georgia Tech. One of the best ways to determine the areas of biology in which you are most interested is to reflect upon the courses you have taken, identifying those that you most enjoyed. Then think about how these courses fit in with your career goals - for example, are you seeking a career in medicine, the biotech industry or in environmental protection? Within these or other areas, it is best to identify the faculty member whose research program most closely fits your interests. You can read about faculty research interests and ongoing projects at http://www.biology.gatech.edu/people/faculty.php. Recent publications of most biology faculty are listed on faculty members’ web pages.

3) After identifying faculty members, tell them about your interest in research and ask to meet with them to discuss their current research projects and your potential participation beginning in a specific semester. At this point it is important to emphasize why you think that an undergraduate research project would be a valuable experience for you and why you would be a good choice for the faculty member. Undergraduate research is a learning opportunity for students AND enables student to make unique contributions to science. So don’t forget that you need to think about how your work will benefit other scientists and our understanding of biology in general, not just how you will benefit.
4) Do not be discouraged if the first professor tells you no. There are many reasons why faculty may not want to take on more undergraduate researchers. The most common is that their lab is full and space and equipment are limited, or they may be over-committed with committee assignments or teaching duties. Your chances of being invited to join a research group are better if you get to know a professor. Take their classes and show an interest in their work. If you are courteously persistent and demonstrate success in your coursework, an opportunity is likely to come your way.

Students who have conducted research in faculty labs feel that it has enhanced their degree and often redirected their career plans. In their own words:

“I believe that the undergraduate research experience that I have gained has been an invaluable rite of passage into becoming an independent, critical thinking scientist. My experience has also been crucial in helping develop a relatively specific set of research interests that I will pursue in graduate school in the fall.”

“Participating in undergraduate research has been one of the best decisions that I could have made during my years at Georgia Tech. More than just doing the experiments, I have enjoyed working with the people. The day-to-day mentoring process is what has helped me more than anything else. I was fortunate enough to work directly with an advisor and numerous graduate students, all of whom took the time to help me develop into a successful scientist.”

“I started doing research as a minor activity, however it quickly became more than that. By my junior year the hours that I worked in lab took highest priority on my academic schedule. The research that I was doing was the link between my classes, my future career options and the real world. Working in lab integrated knowledge from all of my classes, and the critical thinking skills that I employed every day in lab were skills that I took to the classroom and to other aspects of my non-academic life.”

“Because of the multidisciplinary nature of my research, I was really able to grasp the application of biology much more than I could have from a lecture or lab course. I also gained confidence in my public presentation skills because so much of doing research is presenting and defending it. It encompasses reading numerous journals and articles, running experiments, analyzing results, presenting, getting feedback, hopefully getting published, and having something to be proud of when your research is complete.”

**OBTAINING LETTERS OF RECOMMENDATION**

To get a job or to get into graduate or professional school, you will need letters of recommendation from the faculty. A letter of recommendation can point out features of your record, habits, or personality that are important in hiring and admission decisions. They can help you get a job or admission to graduate or professional program when your grades are not as high as those of other candidates.

Faculty members are more willing to write recommendation letters and can write stronger letters if they know you well. The most common way to get to know faculty is to do research in their lab or to take an interactive, small course with them. You will likely need at least three letters of reference, so start developing relationships with faculty as soon as possible.

**Content of Strong Letters**

To be valuable, the letter must contain information that is not available elsewhere in your written record. The writer should be able to comment on your work ethic, ability to solve problems, creativity, reliability, accuracy, receptiveness to coaching, ability to work independently, and
ability to work cooperatively with colleagues.

Medical School Letter of Evaluation (LOE) guidelines request the writer to explain the unique contributions of the student as well as provide an assessment and evidence of the following competencies:
1. Thinking & Reasoning, including Critical Thinking, Quantitative Reasoning, Scientific Inquiry, and Written Communication
2. Science, including Living Systems and Human Behavior
3. Interpersonal, including Service Orientation, Social Skills, Cultural Competence, Teamwork, and Oral Communication
4. Intrapersonal, including Ethical Responsibility to Self and Others, Reliability and Dependability, Resilience and Adaptability, Capacity for Improvement

The letter also should contain details to justify the recommendation. A simple statement that you are a good or smart person is almost meaningless unless it is accompanied by factual information to back up that claim. A lack of details suggests that the writer does not have such evidence and/or does not know much about you.

The reference letter should not be a mere recitation of your good points. No one is perfect, and any attempt to paint you that way will trigger justified doubts in the mind of the reader. It is reasonable for the letter to point out that your record has some weakness, and then to point out how you have overcome the weakness. This converts the negative point into a positive one.

Requesting a letter
First, you must start preparing now for the day when you will need the letter. Get to know at least three professors and encourage them to get to know you. You can do this several ways: Visit with them for at least 30 minutes each semester in office hours or through an event such as Take-a-Prof to lunch, participate at a high level in their courses (especially those with small class sizes and lots of discussion), or do research in their lab. However you do it, invest the time that is necessary. Only after the professor really gets to know you will he or she be able to write a persuasive letter for you.

Second, you should ask the letter writer if he or she is able to write a good letter. If they hedge in any way, thank them and go elsewhere.

Third, if they feel that they can write a good letter, ask them if they can meet whatever deadline you have. Again, if they hedge, go elsewhere. A good letter that remains unwritten or unsent is no letter at all. Always check back with the letter writer a few days before the letter is due at its destination.

The Student’s Role
Most importantly, try to be the kind of person about whom a good letter can easily be written.

It is your job to identify appropriate letter writers, and you should start early in your career to cultivate relationships with them. Ask professors and other students to recommend reliable people. Don’t be afraid to reject the ones who do not seem promising.

When the time comes to request the letter, give the writer sufficient advanced notice (at least 2-4 weeks) and all of the materials that helps them do a good job: a copy of your résumé and details of the program you are applying for. Since faculty members usually have many students asking for reference letters, you should present them with a typed list of the email addresses, or typed, addressed envelopes that contain the correct postage. If he or she cannot write the letter in a timely manner, take that as a message to find someone else.
Finally, waiving your right of access to the letter is a signal that you trust the writer. If you do not trust the writer, you should not ask him or her for a letter in the first place.

**PROBLEMS WITH A PROFESSOR**

There may come a time when you get upset with a professor. When this happens you should understand two things: 1) conflicts may occur when people work closely together, and 2) there is usually a satisfactory way to resolve the conflict.

As a student you will develop a working relationship with the faculty of Georgia Tech. This relationship is not symmetrical, because faculty members evaluate your performance and decide about your grades. That system is not likely to change, probably for very good reasons. After all, professors have already demonstrated their advanced academic qualifications, and you came to Tech to learn some of the things that they know.

Any relationship that is emotionally and intellectually close, especially an asymmetrical one, may generate stresses. Therefore, we need to anticipate them and find a way to deal with them. The solution you find will almost certainly be imperfect, but there is no reason that it need be unsatisfactory. The more unrealistic your initial expectations are, the more imperfect the solution will be to you. So, start out with this dose of reality; *most problems can be solved, but you may have to compromise.* Talk to your professor about the problem. If you are not satisfied with the result, talk to your advisor and if you still need help, consult the Associate Chair for the Undergraduate Program.

If you wish to pursue a formal grievance procedure, you should consult the Georgia Tech Registrar's website at [http://www.catalog.gatech.edu/rules/20c.php](http://www.catalog.gatech.edu/rules/20c.php).

**ADVICE FOR STUDENTS**

Take advantage of everything Tech and Atlanta have to offer by getting involved. A great way to meet people is through intramurals, fraternities and sororities, and the Student Government Association (SGA). SGA publishes a Student Handbook of Campus Organizations that includes all of the on-campus organizations. You should have received one in your FASET packet, but they are also available in the SGA office in the Student Services Building. If you have an artistic side, you can fulfill your creative urges with many of the classes offered in the “Options Guide”, available in the Student Center Box Office. Some of the activities available are ceramics, pottery, salsa lessons, piano lessons, photography, and drawing classes.

There are many fun things to do and see in Atlanta. The Georgia Aquarium, High Museum of Art, Stone Mountain, Zoo Atlanta, Atlanta Botanical Garden, Fernbank Natural History Museum, and the World of Coca-Cola are definitely worth the entry fees. Six Flags and White Water are fun theme parks in the area. The Robert Ferst Center for the Arts, the Atlanta Symphony Orchestra, the Fox Theater, the Atlanta Ballet, and the Shakespeare Tavern offer something for everyone. Information and discount tickets are available for activities around town at the Student Center Box Office on the second floor of the Student Center. Experience the numerous restaurants and theaters around Atlanta, and take your student ID; many places offer student discounts. There are many free publications, such as “Creative Loafing” magazine, that detail up and coming events in Atlanta, or you can check in the Access Atlanta section of the *Atlanta Journal-Constitution*.

Good time management is the key. Do not schedule so many classes that you do not have time for friends and relaxation. On the other hand, if you schedule only two classes per semester
because you want to hang out with your new friends, you will probably never graduate. The right mix will be a balance of work and leisure so that you get good grades, yet thoroughly enjoy yourself. By getting involved and trying new activities, you will soon find your niche. The most successful students have developed good time management skills to include both work and leisure activities.

Be sure to check the Biology Advising Tsquare website frequently for summer jobs, seminars, and research opportunities. You should attend several Biology seminars (advertised on the School of Biology webpage) before your senior year to get a feel for what is expected when you present your research in Senior Seminar and for what kinds of research careers are available to biologists. Usually you will find that the students with the highest grades are the ones who attend class every day, sit in the front rows and ask questions, and study well in advance of tests.

The key to a successful career as a Biology student at Georgia Tech is hard work, focus, good time management, and networking with as many people as possible to create important contacts for the future.

**BIOLOGY COURSE LISTINGS**

All prerequisite courses require a D unless otherwise specified.

**BIOL 1510 - Biological Principles**
An introduction to the basic principles of modern biology, including biomacromolecules, bioenergetics, cell structure, genetics, homeostasis, evolution, and ecological relationships.
4.000 Credit hours, 3.000 Lecture hours, 3.000 Lab hours

**BIOL 1511 - Honors Biological Principles**
An advanced introduction to the principles of modern biology, including biomacromolecules, bioenergetics, cell structure, genetics, homeostasis, evolution, and ecological relationships. Intended for all Biology majors and Honors Program students.
4.000 Credit hours, 3.000 Lecture hours, 3.000 Lab hours

**BIOL 1520 - Intro to Organismal Biology**
An introduction to biology at the organ and organismal levels, with emphasis on physiological processes and integration of growth and development.
4.000 Credit hours, 3.000 Lecture hours, 3.000 Lab hours

**BIOL 1521 - Honors Organismal Biology**
Introduction to biology at the organ and organismal levels, with emphasis on biodiversity, physiological processes, and integration of growth, reproduction and development. Intended for all Biology majors and Honors Program students.
4.000 Credit hours, 3.000 Lecture hours, 3.000 Lab hours

**BIOL 2100 – Biogeography - New Zealand**
Introduction to theory of island biogeography focused on New Zealand's geological history and unique biota.
3.000 Credit hours, 3.000 Lecture hours

**BIOL 2335 - General Ecology**
Introduction to ecological processes at individual, population, and community levels that occur in plant, animal, and microbial taxa, and their relevance to current environmental problems.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 1510 or BIOL 1511

BIOL 2336 - General Ecology Lab
The companion laboratory for BIOL 2335 (Ecology). This course stresses understanding ecological concepts through a combination of lab and field experiments, and computer simulations.
1.000 Credit hours, 0.000 Lecture hours, 3.000 Lab hours
Corequisites: BIOL 2335
Prerequisites: BIOL 1510 or BIOL 1511

BIOL 2337 - Honors Ecology
A problem-based learning course in ecology. Student teams will do research and solve challenges typically faced by ecologists and environmental scientists.
3.000 Credit hours, 3.000 Lecture hours
Corequisites: BIOL 2338
Prerequisites: BIOL 1510 Minimum Grade of B or BIOL 1511 Minimum Grade of B

BIOL 2338 - Honors Ecology Lab
Companion course to Honors Ecology. Student teams will explore solutions to ecological challenges using experiments and mathematical models.
1.000 Credit hours, 0.000 Lecture hours, 3.000 Lab hours
Prerequisites: BIOL 1510 Minimum Grade of B or BIOL 1511 Minimum Grade of B

BIOL 2344 - Genetics
Mendelian and molecular genetics; principles of inheritance, gene structure and function, foundations of recombinant DNA technology, genetic basis of variation and evolution.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 1510 or BIOL 1511

BIOL 2345 - Genetics Laboratory
A laboratory course in the fundamental techniques of genetic analysis.
1.000 Credit hours, 0.000 Lecture hours, 3.000 Lab hours
Corequisites: BIOL 2344
Prerequisites: BIOL 1510 or BIOL 1511

BIOL 2354 - Honors Genetics
A comprehensive genetics course incorporating discussions of primary literature. Topics include molecular genetics and gene action, transfer systems and mapping, cytological, quantitative and population genetics.
3.000 Credit hours, 3.000 Lecture hours
Corequisites: BIOL 2355
Prerequisites: BIOL 1510 Minimum Grade of B or BIOL 1511 Minimum Grade of B

BIOL 2355 - Honors Genetics Lab
Hands-on introduction to practical techniques, critical thinking, and important concepts in genetics. Students carry out laboratory experiments that explore transmission, population, and molecular genetics.
1.000 Credit hours, 0.000 Lecture hours, 3.000 Lab hours
Corequisites: BIOL 2354
Prerequisites: BIOL 1510 Minimum Grade of B or BIOL 1511 Minimum Grade of B
BIOL 2400 - Math Models in Biology
Introductory probability and deterministic models in biology, including discrete and continuous probability distributions and dynamic models from molecular and cellular biology to ecology and epidemiology.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: (MATH 1502 or MATH 1512 or MATH 1522) and (BIOL 1510 or BIOL 1511)

BIOL 2698 - Research Assistantship
Independent research conducted under the guidance of a faculty member.
1.000 TO 12.000 Credit hours, 1.000 TO 12.000 Lecture hours

BIOL 2699 - Undergraduate Research
Independent research conducted under the guidance of a faculty member.
1.000 TO 12.000 Credit hours, 1.000 TO 12.000 Lecture hours

BIOL 280X - Special Topics
This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological sciences.
X Credit hours, X Lecture hours

BIOL 290X - Special Problems
Research problems in biology under the supervision of a faculty member.
1.000 TO 21.000 Credit hours, 1.000 TO 21.000 Lecture hours

BIOL 3100 – Ecology & Evolution - Australia
Evolution and ecology of Australian ecosystems, including rainforests, open woodlands, coastal habitats; conservation of endangered ecosystems. Earns Biology technical credit. Research project required.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 2100

BIOL 3300 - Tropical Ecology
Ecological processes in the tropics including community organizations, biotic interactions, biodiversity, coevolution. Students perform research projects in rain forest, cloud forest, and seashore.
0.000 OR 3.000 Credit hours, 0.000 OR 1.000 Lecture hours, 0.000 OR 6.000 Lab hours
Prerequisites: BIOL 1510 or BIOL 1511

BIOL 3380 - Intro Microbiology
Basic biology of bacteria, fungi, algae, and viruses, with emphasis on bacteriology.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: (BIOL 1510 or BIOL 1511) and CHEM 2311

BIOL 3381 - Intro Microbiology Lab
Fundamental laboratory techniques in microbiology.
1.000 Credit hours, 0.000 Lecture hours, 3.000 Lab hours
Corequisites: BIOL 3380
Prerequisites: (BIOL 1510 or BIOL 1511) and CHEM 2311
BIOL 3450 - Cell Molecular Biology
An introduction to the structure and function of cells and their organelles with emphasis on
eukaryotic cellular and molecular processes.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: (BIOL 1510 or BIOL 1511) and (CHEM 2311 or CHEM 1315)

BIOL 3451 - Cell Molecular Biology Lab
An introduction to experimental methods of cell and molecular biology research that will cover
some fundamental topics of cell biology.
0.000 OR 1.000 Credit hours, 0.000 Lecture hours, 0.000 OR 3.000 Lab hours
Corequisites: BIOL 3450
Prerequisites: (BIOL 1510 or BIOL 1511) and (CHEM 2311 or CHEM 1315)

BIOL 3600 - Intro Evolutionary Biology
Comprehensive introduction to evolutionary biology. Includes focus on processes (natural
selection, genetic drift) and resulting patterns (genome organization, phylogeny) illustrated with
prokaryote and eukaryote examples.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 2344 or BIOL 2354 and (BIOL 2335 or BIOL 2337)

BIOL 3753 – Human Anatomy
Detailed study of human body structures using a regional and systems approach. Emphasis is
placed on structural relationships and the integration of body systems.
3.000 Credit hours, 3.000 Lecture hours. Crosslisted with APPH 3753.
Prerequisites: BIOL 1520 or BIOL 1521 or CHEM 1211K or CHEM 1310

APPH 3754 - Anatomy Lab
A detailed hands-on study of human structure using high-resolution models, specialized
specimens and dissection of selected mammalian organs and tissues. Crosslisted with
APPH 3754.
1.000 Credit hours, 0.000 Lecture hours, 3.000 Lab hours
Prerequisites with concurrency: APPH 3753 or BIOL 3753

BIOL 3755 - Human Physiology
Students will explore the function and adaptation of the human body emphasizing
neuromuscular, cardio-respiratory, gastrointestinal, endocrine, and urinary systems to maintain
homeostasis and human health. Crosslisted with APPH 3755.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: APPH 3753 or BIOL 3753

APPH 3756 - Physiology Lab
A laboratory application of concepts in Physiology, providing hands-on experience
focusing primarily on non-invasive human experiments supplemented with in vitro
tissues experiments. Crosslisted with APPH 3756.
1.000 Credit hours, 3.000 Lab hours
Prerequisites with concurrency: APPH 3755 or BIOL 3755

BIOL 3813 - Special Topics
Topics of current interest not covered in other courses in the department.
3.000 Credit hours, 3.000 Lecture hours
BIOL 4012 - Protein Biology  
Biological view of proteins, including: protein biosynthesis, processing, modifications, folding, trafficking, interactions, degradation, natural and directed evolution, protein assembly diseases, amyloids, prions and protein-based inheritance.  
3.000 Credit hours, 3.000 Lecture hours  
Prerequisites: BIOL 1510 or BIOL 1511

BIOL 4015 - Cancer Biology & Technology  
This course covers basic concepts of cancer biology and new technologies that are being developed to understand, detect, treat, and prevent cancer.  
3.000 Credit hours, 3.000 Lecture hours  
Prerequisites: BIOL 1510 or BIOL 1511 or BIOL 1520 or BIOL 1521 or CHEM 1310 or CHEM 1211K or CHEM 1212K or PHYS 2211 or PHYS 2212 or EAS 1600 or EAS 1601 or EAS 2600

BIOL 4101 - Sensory Ecology  
A quantitative analyses of communication channels and information acquisition involving visual, auditory, mechanosensory, and olfactory modalities across a range of species and habitats.  
3.000 Credit hours, 3.000 Lecture hours  
Prerequisites: BIOL 2335 or BIOL 2337

BIOL 4105 - Macromolecular Modeling  
Principles and practices in the use of molecular mechanics methods (minimization; molecular dynamics) to study structure-function relationships in biological macromolecules.  
4.000 Credit hours, 4.000 Lecture hours

BIOL 4150 – Genomics & Applied Bioinformatics  
Retrieval and analysis of biological sequence, gene expression, and proteomics data from public databases and other sources; applying standard bioinformatics tools to investigate biological questions.  
0.000 OR 3.000 Credit hours, 0.000 OR 2.000 Lecture hours, 0.000 OR 3.000 Lab hours  
Prerequisites: BIOL 2344 or BIOL 2354 and (CS 1321 or CS 1371 or CS 1301 or CS 1315)

BIOL 4221 - Biological Oceanography  
An introduction to the major biological processes in the ocean including primary production, elemental cycling, food webs, and fisheries.  
3.000 Credit hours, 3.000 Lecture hours  
Prerequisites: BIOL 1510 or BIOL 1511

BIOL 4225 - Molecular Evolution  
Evolutionary processes at molecular level, organizations of genomes and genetic systems.  
Students will read and present up-to-date research articles in various topics in molecular evolution.  
3.000 Credit hours, 3.000 Lecture hours  
Prerequisites: BIOL 3600

BIOL 4340 - Medical Microbiology  
Advanced study of bacteria, protozoa, fungi, and viruses that cause human diseases; emphasis on epidemiology, mechanisms of disease causation, prevention, and treatment.  
3.000 Credit hours, 3.000 Lecture hours  
Prerequisites: BIOL 3380
BIOL 4401 - Experimental Design & Statistical Methods
Introductory course on experimental design, hypothesis testing and basic statistical techniques commonly applied in biological research. Exercises based on computer statistical software packages.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: MATH 1502 or MATH 1512 or MATH 1522 and (BIOL 1510 or BIOL 1511)

BIOL 4410 - Microbial Ecology
Advanced studies of microbial ecosystems, the specific roles of bacteria in maintaining ecological balance, and the evolution of the ecosystem in response to changing environments.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 3380

BIOL 4417 - Marine Ecology
An overview of the physical forces and biotic interactions structuring marine communities and of the major threats to these communities.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 2335 or BIOL 2337

BIOL 4418 - Microbial Physiology
Study of the physiology of growth and metabolic activities of microorganisms.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 3380 and BIOL 3450

BIOL 4422 - Theoretical Ecology
Theoretical foundations of ecology, from the population to the community and ecosystem levels.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: MATH 2403 or BIOL 2400

BIOL 4440 - Plant Physiology
Chemical transformation in photosynthesis, photophysiology and water relationships, organic nutrition and effects of hormones on growth and development of plants.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 1510 or BIOL 1511 and BIOL 1520 or BIOL 1521

BIOL 4446 - Animal Physiology
Systems physiology including nerves, muscles, kidney, digestion, circulation, endocrinology, reproduction, and respiration.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 3450

BIOL 4450 - Senior Seminar
Senior students present seminars on recent research topics based on their own research experience and/or literature research.
1.000 Credit hours, 1.000 Lecture hours
Prerequisites: BIOL 4590 or BIOL 4690 or BIOL 4910

BIOL 4464 - Developmental Biology
Investigations of cell differentiation and development using the tools of molecular genetics and cell biology.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: (BIOL 2344 or BIOL 2354) and BIOL 3450
BIOL 4471 - Behavior Biology
An introduction to the study of the principles of behavior of all kinds of organisms, from microbes to mammals.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 1510 or MATH 1511 and (MATH 1502 or MATH 1512 or MATH 15X2) and PHYS 2212

BIOL 4478 - Biophysics
Biophysical aspects of nucleic acids, proteins, and their interactions.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: PHYS 2211 and (BIOL 2344 or BIOL 2354 or BIOL 3450)

BIOL 4480 – Evolutionary Developmental Biology
This course teaches students how the process of development from embryo to adult impacts evolutionary diversity and human health.
2.000 Credit hours, 2.000 Lecture hours
Prerequisites: BIOL 3600

BIOL 4545 - Human Genetics
Introduction to the genetics and evolution of complex human traits, focusing on contemporary approaches to understanding susceptibility to malignant, metabolic, immune and psychological diseases.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: Undergraduate Semester level BIOL 2344 or BIOL 2345

BIOL 4570 - Immunology & Immunochemistry
A survey of modern immunology and its applications.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 3450 and (BIOL 2344 or BIOL 2354)

BIOL 4590 - Research Project Lab
Experience in designing, implementing, and communicating a biology research project, and practical training in modern approaches for biological research.
0.000 OR 3.000 Credit hours, 0.000 OR 1.000 Lecture hours, 0.000 OR 6.000 Lab hours
Corequisites: BIOL 4450
Prerequisites: BIOL 1510

BIOL 4608 - Prokaryotic Molecular Genetics
The molecular genetics of bacteria and their viruses, with emphasis in the organization, replication, expression, transfer and experimental manipulation of prokaryotic genes and genomes. Credit not allowed for both BIOL 4220 and BIOL 4608.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 2344 or BIOL 2354

BIOL 4620 - Aquatic Chemical Ecology
Focuses on understanding the chemical mechanisms of aquatic signaling and the cascading effects on population regulation, community organization, and ecosystem function.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 2335 or BIOL 2337
BIOL 4650 - Bioethics
This course will examine the process of scientific inquiry and the ethical implications of research in the biological sciences.
2.000 Credit hours, 2.000 Lecture hours
Prerequisites: BIOL 1510 or BIOL 1511

BIOL 4668 - Eukaryotic Mol Genetics
Topics in molecular genetics, including genetic engineering techniques, gene expression and regulation, genetic structure, stability and evolution, with emphasis on eukaryotic organisms.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 2344 or BIOL 2354

BIOL 4690 - Independent Research Project
Independent research with proposal and manuscript writing, conducted with the guidance of a faculty member.
3.000 Credit hours, 0.000 Lecture hours, 9.000 Lab hours
Prerequisites: BIOL 2698 or BIOL 2699 or BIOL 4698 or BIOL 4699

BIOL 4696 - Biology Teaching Assistant
Biology teaching carried out under the guidance of a faculty member. Permit only.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: CETL 2000

BIOL 4697 - Biology Undergraduate Teaching
An introduction to teaching biology for undergraduate teaching assistants, with a focus on effective teaching active engagement of students, and development of innovative classroom activities. Permit only.
0.000 OR 3.000 Credit hours, 0.000 OR 1.000 Lecture hours, 0.000 OR 6.000 Lab hours
Prerequisites: CETL 2000

BIOL 4698 - Research Assistantship
Independent research conducted under the guidance of a faculty member.
1.000 TO 12.000 Credit hours, 1.000 TO 12.000 Lecture hours

BIOL 4699 - Undergraduate Research
Independent research conducted under the guidance of a faculty member.
1.000 TO 12.000 Credit hours, 1.000 TO 12.000 Lecture hours

BIOL 4740 - Bio-Inspired Design
We examine evolutionary adaptation as a source for engineering design inspiration, utilizing principles of scaling, adaptability, and robust multifunctionality that characterize biological systems.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 1520 or BIOL 1521 or BIOL 3600 or BMED 3100 or PHYS 2211

BIOL 4746 - Signaling Molecules
The diversity of chemical signals between organisms and their structural specifications will be presented along with chemical and biological methods for isolating signaling molecules.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 1510 or BIOL 1511 and CHEM 2311
**BIOL 4752 - Intro Neuroscience**
Goals are to understand the components of the nervous system and their functional interactions, and appreciate the complexity of higher order brain functions and pathways. Crosslisted with BMED 4752.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: BIOL 3450 or BMED 3160

**BIOL 4755 - Mathematical Biology**
An introduction to practical applications of mathematical models to help unravel the underlying mechanisms involved in biological processes. Crosslisted with MATH 4755.
3.000 Credit hours, 3.000 Lecture hours
Prerequisites: MATH 2403 or BIOL 2400

**BIOL 480X - Special Topics**
This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological science.
X Credit hours, X Lecture hours

**BIOL 490X - Special Problems**
Research problem in biology under supervision of a faculty member. To be offered any term with credit to be arranged. Seven hours (four hours technical electives + three hours free elective) are the maximum credits allowed toward the Bachelor of Science in Biology degree.
1.000 TO 21.000 Credit hours, 1.000 TO 21.000 Lecture hours

**BIOL 4910 - Honors Research Thesis**
Writing and submission of an Undergraduate Research Thesis describing research accomplishments with a biology faculty member.
3.000 Credit hours, 0.000 Lecture hours, 9.000 Lab hours
Corequisites: BIOL 4450
Prerequisites: (BIOL 2698 or BIOL 2699) or BIOL 4698 or BIOL 4699

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**NON-BIOLOGY COURSES THAT ARE APPROVED FOR BIOLOGY ELECTIVES**
(9 credits maximum)

**LMC:**
- LMC 4701 Undergraduate Research Proposal Writing
- LMC 4702 Undergraduate Research Thesis Writing

**All APPH 3XXX and higher courses EXCEPT:**
- APPH 3300 Health Promotion
- APPH 3901-3904 Special Problems
- APPH 4698 Research Assistantship
- APPH 4699 Undergraduate Research

**All BMED 3XXX and higher courses EXCEPT:**
- BMED 4698 Research Assistantship
- BMED 4699 Undergraduate Research
- BMED 4900-4903 Special Problems
All CHEM 3XXX and higher courses EXCEPT:
CHEM 4601  Chemistry Seminar
CHEM 4698  Research Assistantship
CHEM 4699  Undergraduate Research
CHEM 4901- 4903 Special Problems in Chemistry

All EAS 3XXX and higher courses EXCEPT:
EAS 4651  Practical Internship
EAS 4698  Research Assistantship
EAS 4699  Undergraduate Research
EAS 4900  Special Problems

All MATH 2XXX and higher courses EXCEPT:
MATH 2698  Research Assistantship
MATH 2699  Undergraduate Research
MATH 4080  Senior Project I
MATH 4090  Senior Project II
MATH 4698  Research Assistantship
MATH 4699  Undergraduate Research
MATH 4999  Special Problems

All PHYS 3XXX and higher courses EXCEPT:
PHYS 4601  Senior Seminar I
PHYS 4602  Senior Seminar II
PHYS 4698  Research Assistantship
PHYS 4699  Undergraduate Research

All PSYC 3XXX and higher EXCEPT:
PSYC 4600  Senior Thesis I
PSYC 4601  Senior Thesis II
PSYC 4698  Research Assistantship
PSYC 4699  Undergraduate Research
PSYC 4900-4910 Special Problems
### A. General Biology (Required)

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<th>Course</th>
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<th>Weekly Credits</th>
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<td>Biol 1511 (or 1510) Biol Princ</td>
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<tr>
<td>Biol 1521 (or 1520) Organ Bio</td>
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<td>Biol 2335 or 2337 Ecology</td>
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<td>Biol 2344 or 2354 Genetics</td>
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<td>Biol 3600 Evolution</td>
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<td>Biol 3450 Cell &amp; Molecular Bio</td>
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<td>Biol 4450 Senior Seminar</td>
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<td>Biol 4150 Genomics &amp; App Binf</td>
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<td>Biol 4401 Exp Des and Stat</td>
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**Total for Graduation 122**

### C. Other Required Courses

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<td>Biol 4690 Ind. Research Proj</td>
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<tr>
<td>Biol 4910 Honors Res Thesis</td>
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**Total 29**

### D.-E. Social Sciences/Humanities

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**Total 12**

### B. Biology Electives (21 hrs req)

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**Total 12**

### F. Free Electives

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**Total 11**

**Total 21**