



**Georgia** Institute  
of **Tech**nology

# **HANDBOOK FOR UNDERGRADUATE STUDENTS**

## **SCHOOL OF BIOLOGY**

 **2013 - 2014** 

## CONTENTS

Introduction .....	3
School of Biology organization .....	3
The long-term goal: Employment and education after graduation.....	4
The short-term goal: B.S. degree requirements .....	4
Academic advising .....	6
Bachelor of Science in Biology 2013-2014 degree requirements.....	11
B.S. degree enhancements.....	12
Biology minor and certificates .....	13
Online Graduation Application.....	16
Common minors and non-biology certificates for biology majors .....	17
University resources.....	17
The cooperative and internship programs.....	18
Awards in the School of Biology.....	18
Activities in the School of Biology.....	19
Undergraduate teaching in the School of Biology .....	20
Undergraduate research in the School of Biology .....	20
Getting letters of recommendation .....	24
Problems with a professor.....	25
Advice from former students .....	25
Research Faculty .....	26
Academic professionals and instructors.....	27
Biology course listings.....	27
Courses from other Schools approved for Biology electives .....	36
Student/advisor work sheet.....	38

## 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 and instructors. The names, academic interests, and phone numbers of all faculty members and instructors 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. Another good resource for information is the School of Biology web page at [www.biology.gatech.edu](http://www.biology.gatech.edu). Information on registering for classes, advisor listings, FAQ's, etc., can be found on the Undergraduate Program page of the Biology web page at <http://www.biology.gatech.edu/undergraduate-program/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

The Chair of the School of Biology is Dr. Terry Snell, who is responsible for the overall operation of the School. The Associate Chair in charge of the Undergraduate Program is Dr. Joseph Montoya. The Associate Chair works directly with the School of Biology Academic Office to ensure smooth operation of the Undergraduate Program. Information on the role of the Academic Office and other administrative areas are shown below:

- I. **School Chair:** Dr. Terry Snell, Professor, Room 201 Cherry Emerson
- II. **Associate Chair for Undergraduate Program:** Dr. Joseph Montoya, 1244 ES&T
- III. **Academic Office:**
  - Academic Advisors: Dr. Mirjana Brockett, 323 Cherry Emerson  
Dr. Linda Green, 474C Clough Commons  
Dr. Shana Kerr, A114 Cherry Emerson  
Dr. Chrissy Spencer, 474D Clough Commons
  - Academic Program Coord: Benita Black, 474E Clough Commons
  - Lab Manager: Marc Pline, 321 Cherry EmersonThe main functions of the Academic Office are to:
  - 1. Coordinate undergraduate academic activities in the School.
  - 2. Act as liaison to other schools 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.
  - 5. Coordinate teaching of introductory biology lab courses.
- IV. **Biology Student Advisory Committee advisor:** Dr. Linda Green
- V. **Tri-Beta Biological Honor Society advisor:** Dr. Jeannette Yen

## THE LONG-TERM GOAL: EMPLOYMENT AND EDUCATION AFTER GRADUATION

**You can go to work immediately after graduation.** 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. Starting a career search, however, is a daunting task. You must start the process early in your career at Tech, preferably before the end of your second year. Career Services (Student Success Center, 2<sup>nd</sup> floor) is a great resource. Check out the resources available on the School of Biology website at <http://www.biology.gatech.edu/undergraduate-program/career/> or the Georgia Tech Undergraduate Studies website at <http://www.undergradstudies.gatech.edu/>.

**You can go to graduate school.** A degree in biology gives you flexibility and the world of biology is diverse - you can attend graduate school in any area from molecular biology, to conservation biology, to engineering, to business, to education.

**You can go to a health 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 options, see page 18 for information on how to contact the School of Biology chapter of the premedical society (the AMSA).

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

The minimum number of total credit hours required for a Bachelor’s degree in Biology is 122.

### Required Biology Core Courses

BIOL 1510/1511	Biological Principles/(or Honors)
BIOL 1520/1521	Intro to Organismal Biology/(or Honors)
BIOL 2335/2337	General Ecology/(or Honors)
BIOL 2344/2354	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 must be taken concurrently with the associated lecture course).

### Required Quantitative Biology Course

One of the following:

BIOL 2400	Mathematical Models in Biology
BIOL 4150	Genomics & Applied Bioinformatics
BIOL 4401	Experimental Design & Biostatistics
BIOL 4422	Theoretical Ecology
BIOL 4755	Mathematical Biology
BIOL 4545	Human Genetics
BIOL 4803	Population Biology
MATH 3770	Statistics & Applications
MATH 3215	Probability & Statistics

The most common courses selected from this list are BIOL 2400, BIOL 4401, or BIOL 4150. The other courses may be appropriate depending on your interests and strengths. If you wish to take a course other than BIOL 2400, BIOL 4401, or BIOL 4150 to fulfill your quantitative requirement, you are encouraged to discuss the decision with your advisor.

### **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
CHEM 2312	Organic Chem II
CHEM 2380	Synthesis Lab
MATH 1501	Calculus I
MATH 1502	Calculus II
PHYS 2211	Intro Physics I
PHYS 2212	Intro Physics II

### **Required Communication and Quantitative Outcomes**

ENGL 1101	English Composition I
ENGL 1102	English Composition II
MATH 1501	Calculus I

For freshmen entering the USG system as of Fall 2012, students who have earned 30 hours but have not completed ENGL 1101 & 1102 and MATH 1501 must enroll in the next course necessary to make progress toward completing this Area in every semester in which they take classes.

### **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 BIOL 4699 can be applied to 21 total hrs. These courses must be taken for a letter grade.

### **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 Perspective. 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, or an equivalent course.

### **Free Electives**

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

## ACADEMIC ADVISING

Shortly after 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:

<u>Last names beginning</u>	<u>Advisor</u>
A–F	Dr. Linda Green
G–L	Dr. Chrissy Spencer
M–R	Dr. Mirjana Brockett
S–Z	Dr. Shana Kerr

Advisors use a web-based scheduling system to arrange advising appointments (<http://www.advising.gatech.edu/appointments>).

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 a mandatory 15 minute advising meeting once each year. Each semester Biology majors will receive an email according to your academic standing, freshmen and sophomores in the Spring and juniors and 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 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>).

This appointment is a chance to work one-on-one with your advisor to devise an optimal pathway to achieve your academic and career goals.

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.

*You are responsible for the success of your own career*, so keeping track of your progress toward the undergraduate degree is highly recommended. 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.

### Frequently asked questions on advisement issues:

#### **Q. What are the required courses for a B.S. in Biology at Georgia Tech?**

A: The B.S. Biology curriculum, including a complete list of required courses, is found at <http://www.biology.gatech.edu/undergraduate-program/current-students/advising/requiredcourses.php> and in this Handbook. Required courses include core Biology courses, courses in chemistry, math, physics, computing, and English. There are also requirements for social sciences, humanities, and wellness courses; and Biology electives and free electives, for a total of 122 semester credit hours.

**Q: Do Biology majors have to repeat courses if they got a “D”?**

A: No.

**Q. What courses can be taken on a pass/fail basis?**

A: Only free electives may be taken on a pass/fail basis. In addition, students with 45-70 Georgia Tech credit hours may only have up to 3 credit hours taken pass/fail. Students with 71-90 Georgia Tech credit hours may have up to 6 pass/fail credits and students with 91 or more Georgia Tech credit hours may have up to 9 pass/fail credits.

**Q: What is DegreeWorks?**

A: DegreeWorks is a web interface that enables students and their advisors to review past, present, and future academic coursework to evaluate which degree requirements are complete and which degree requirements are remaining. You can review your coursework and progress towards graduation anytime at [degreeworks.gatech.edu](http://degreeworks.gatech.edu) and signing in using your GaTech ID and password. The “What If” tool can be used to explore how progress towards degree completion changes if you change majors.

**Q: What counts as Undergraduate Research credits?**

A: Undergraduates can perform research with Biology faculty for academic credit. Freshmen and sophomores register for BIOL 2699. Juniors and seniors register for BIOL 4699 (1-12 credit hrs). BIOL 2699 credits count towards graduation requirements as free electives. Up to 6 credits of BIOL 4699 can count as Biology electives; additional BIOL 4699 credits count as free electives. Freshmen and sophomores doing research for pay should register for BIOL 2698, juniors and seniors register for BIOL 4698 – these are non-credit, audit-only courses. Students doing research off-campus during the summer should still register for BIOL 2698 or 4698 (there is no charge for these audit-only courses). To perform undergraduate research for credit or pay, students must have permission from the faculty member in whose lab the research will take place. Permission is documented using the Permit Request form available at <http://www.biology.gatech.edu/undergraduate-program/current-students/docs/bio-overload-form.pdf>.

If a student wishes to conduct research with a faculty member in another School (e.g., Chemistry & Biochemistry or Biomedical Engineering) on a research project that has a biological focus, then it might be possible to get BIOL 2699/4699 credit for this work, if the student and their research advisor can get the agreement of a School of Biology faculty member to serve as co-advisor *before* the start of the research project. See Dr. Jung Choi for details.

NOTE: During registration using OSCAR, default credit for BIOL 2699/4699 is set at 1 credit hour. A student must "change course basis" on the Oscar registration page to change credit hours from 1 to whatever the faculty member and student agree to. When the student registers, he/she should include the "section" of the course on the permit form. The section is the first 3 letters of the faculty member's last name.

**Q: How are credit hours calculated for BIOL 2699/4699 Undergraduate Research?**

A: Rule of thumb is to treat these courses as laboratories: 3 hrs weekly in lab for each credit hour.

**Q: What is the Senior Research Experience?**

A: All Biology majors must complete a Senior Research Experience in order to graduate. This consists of BIOL 4590 (Research Project Lab) or BIOL 4690 (Independent Research Project) or BIOL 4910 (Honors Research Thesis). Each of these research-based courses counts for 3 credits; BIOL 4690 or 4910 is taken with a School of Biology faculty member by working in their

lab on a project of a student's own design. BIOL 4590 is a lab-based course taught by a Biology faculty member.

**Q: When should I take BIOL 4450 Senior Seminar?**

A: If a student takes BIOL 4590 (Research Project Lab) to fulfill their Senior Research Experience, then they must take BIOL 4450 (Senior Seminar) during the same semester. If they choose BIOL 4690 (Independent Research Project) or BIOL 4910 (Honors Research Thesis) to fulfill their Senior Research Experience, then they may take BIOL 4450 concurrently, or during the semester immediately after taking BIOL 4690/4910. In the Senior Seminar class, students will be presenting the results of their Senior Research Experience, thus it is not allowable to take Senior Seminar before starting this research.

**Q. When does a student have to use a permit request or prerequisite override form?**

A permit request form is submitted by a student when OSCAR either says "Permit required" or the student wants to request that registration restrictions for a course be overridden. Permit request forms are at <http://www.biology.gatech.edu/undergraduate-program/current-students/docs/bio-overload-form.pdf>. Have the professor sign the form and return it to Benita Black in Clough 474.

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>) directly to Benita Black in Clough 474. Be sure to include contact information.

None of these requests may be made by phone or by email. Allow 24 hours for the form to be processed.

**Q: Can students take chemistry, physics, or math courses (or any other courses) at Georgia Perimeter (or other community college)?**

A: Maybe. But they have to be careful that the course they take will be accepted as transfer equivalents by the relevant school at Tech (chemistry, physics, math, etc). They can look up the transfer equivalency table on OSCAR ([https://oscar.gatech.edu/pls/bprod/wwtraneq.P\\_TranEq\\_Ltr](https://oscar.gatech.edu/pls/bprod/wwtraneq.P_TranEq_Ltr)). If the course is not listed, check with the relevant department at Georgia Tech to assess whether the course can be transferred in. Also, students must be careful of the 36-hr rule (see below). Additionally, many medical schools only accept prerequisite courses taken at four-year institutions. Also, students may not receive transfer credit from a course taken at another institution when concurrently enrolled at Georgia Tech.

**Q: How do you check to see if a course will transfer from another university?**

A: Go to the web site: [https://oscar.gatech.edu/pls/bprod/wwtraneq.P\\_TranEq\\_Ltr](https://oscar.gatech.edu/pls/bprod/wwtraneq.P_TranEq_Ltr) and choose the college of interest. Scroll through the list of courses and determine if Georgia Tech credit is given for the course. If the college or course is not listed, it must be evaluated for transfer credit by Dr. Jung Choi ([jung.choi@biology.gatech.edu](mailto:jung.choi@biology.gatech.edu)). You need to submit the name of the college, course, and class syllabus for the evaluation.

**Q: What is the 36-hour rule?**

A: The rule states that students must complete the last 36 credit hours of their degree program in residence at Georgia Tech. Exceptions may be granted by petition to the faculty, and

approval of the petition by 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.

**Q: Can a student substitute course XYZ as a Biology elective?**

A: If the course is not an approved Biology elective (see this Handbook or <http://www.biology.gatech.edu/undergraduate-program/current-students/advising/requiredcourses.php>), then it may still be allowable as a Biology elective if it is a 3XXX or 4XXX level course with pre-requisites and the student's advisor and Associate Chair for Undergraduate Program both agree that it has relevance to the student's major studies.

**Q: What courses fulfill the CS requirement for Biology majors?**

A: Any course determined by the Institute Undergraduate Curriculum Committee as allowable for the Institute general education CS requirement is OK for Biology majors. Currently, these include CS 13X1 (transfer course), CS 1301, CS 1315, CS 1371, and COE 1361 (restricted to certain engineering majors, but OK if they change major to Biology).

**Q: What courses can be used as humanities or social sciences requirements?**

A: These courses are listed in the catalog and Registrar's web site (<http://www.catalog.gatech.edu/students/ugrad/core/core.php>), in the section Information for Undergraduate Students, Core Curriculum, Core Area C (humanities and fine arts), and Core Area E (social sciences). Note that some courses that satisfy Areas C and E may also satisfy the Global Perspectives Overlay area

**Q: Is it true that there are no limits on how many hours of 2699/4699 Undergraduate Research credits can be applied to the FREE electives requirement for a BS in Biology?**

A: Yes.

**Q: How do I apply to graduate?**

A: Biology students submit an Online Application for Graduation (OAG) during their penultimate semester. Full instructions for this process are available at <http://www.biology.gatech.edu/undergraduate-program/current-students/docs/Online%20Graduation%20Application%20Instructions.pdf>. For additional information regarding the OAG, please see: <http://registrar.gatech.edu/students/oag>.

**Q: How do I get readmitted to Georgia Tech after being out of school?**

A: Students who for any reason have remained out of school for two or more consecutive semesters must apply for readmission (<http://www.registrar.gatech.edu/students/readmission.php>). The readmission application along with any transcripts, petitions, and other supporting information must be submitted to the Readmission Office, in room 103 of the Tech Tower (Administration Building) or mailed to: Georgia Institute of Technology, Office of the Registrar, Readmission, Atlanta, GA 30332-0315. Students applying for readmission after academic dismissal must complete the School of Biology Readmission Application ([http://www.biology.gatech.edu/undergraduate-program/current-students/docs/Package\\_for\\_Readmission-Biology%5B2%5D.pdf](http://www.biology.gatech.edu/undergraduate-program/current-students/docs/Package_for_Readmission-Biology%5B2%5D.pdf)) and meet all deadlines therein.

**Q: What are the rules governing student conduct?**

A: Georgia Tech has a Code of Conduct to which all students must adhere (<http://www.osi.gatech.edu/pdf/Student%20Code%20of%20Conduct%20-%20202-22-11%281%29.pdf>). In addition, an Honor Code (<http://www.honor.gatech.edu/plugins/content/index.php?id=9>) governs all academic activities. You should read these and familiarize yourself with your rights and responsibilities.

**Q. What is the suggested plan of study for Biology majors?**

A: Students need to average 15.25 credit hours per semester to graduate in four years.

**Q: Do Biology majors need to complete an Ethics Requirement?**

Biology does not require an Ethics course to receive a B.S. in Biology.

**Q: Do I have to take extra courses to complete the Global Perspectives overlay?**

The Global Perspectives overlay can be met with specific Core Area C (Humanities) or Core Area E (Social Sciences) courses, as listed at

<http://www.catalog.gatech.edu/students/ugrad/core/gp.php> . Students may use courses from this list to fulfill both requirements (Humanities and Global, or Social Sciences and Global) at the same time.

## BACHELOR OF SCIENCE IN BIOLOGY 2013-2014 DEGREE REQUIREMENTS

FIRST YEAR-FALL	HOURS
GT 1000 FRESHMAN SEMINAR*	1
ENGL 1101 ENGLISH COMPOSITION I	3
MATH 1501 CALCULUS I	4
BIOL 1510 OR 1511 BIOLOGICAL PRINCIPLES	4
CHEM 1211K CHEMICAL PRINCIPLES I	4
<b>TOTAL SEMESTER HOURS</b>	<b>16</b>

FIRST YEAR-SPRING	HOURS
ENGL 1102 ENGLISH COMPOSITION II	3
MATH 1502 CALCULUS II	4
BIOL 1520 OR 1521 INTRODUCTION TO ORGANISMAL BIOLOGY <sup>1</sup>	4
CHEM 1212K CHEMICAL PRINCIPLES II	4
<b>TOTAL SEMESTER HOURS</b>	<b>15</b>

SECOND YEAR-FALL	HOURS
BIOL 2335 ECOLOGY OR BIOL 2354 HONORS GENETICS <sup>2</sup>	3
BIOL 2336 ECOLOGY LAB OR BIOL 2355 HONORS GENETICS LAB <sup>2</sup>	1
PHYS 2211 INTRODUCTORY PHYSICS I	4
CHEM 2311 ORGANIC CHEMISTRY I	3
FREE ELECTIVE or QUANTITATIVE BIOLOGY REQUIREMENT	3
WELLNESS	2
<b>TOTAL SEMESTER HOURS</b>	<b>15 or 16</b>

SECOND YEAR-SPRING	HOURS
BIOL 2344 GENETICS OR BIOL 2337 HONORS ECOLOGY <sup>2</sup>	3
BIOL 2345 GENETICS LAB OR BIOL 2338 HONORS ECOLOGY LAB <sup>2</sup>	1
CHEM 2312 ORGANIC CHEMISTRY II	3
CHEM 2380 SYNTHESIS LAB	2
COMPUTING REQUIREMENT	3
QUANTITATIVE BIOLOGY REQUIREMENT <sup>3</sup> or FREE ELECTIVE	3
<b>TOTAL SEMESTER HOURS</b>	<b>14 or 15</b>

THIRD YEAR-FALL	HOURS
BIOL 3450 CELL & MOLECULAR BIOLOGY OR BIOL 3600 EVOLUTION	3
BIOL 3451 CELL & MOLECULAR BIOLOGY LAB	1
BIOLOGY ELECTIVE(S)	3
FREE ELECTIVE	2
PHYS 2212 INTRODUCTORY PHYSICS II	4
SOCIAL SCIENCE ELECTIVE(S)	3

THIRD YEAR-SPRING	HOURS
BIOL 3450 CELL & MOLECULAR BIOLOGY OR BIOL 3600 EVOLUTION	3
BIOL 3451 CELL & MOLECULAR BIOLOGY LAB	1
BIOLOGY ELECTIVE(S)	6
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200	3
HUMANITIES ELECTIVE(S)	3
<b>TOTAL SEMESTER HOURS</b>	<b>15 or 16</b>

FOURTH YEAR-FALL	HOURS
SENIOR RESEARCH EXPERIENCE <sup>4</sup>	3
BIOLOGY ELECTIVE(S)	6
FREE ELECTIVE(S)	3
SOCIAL SCIENCE ELECTIVE(S)	3
BIOL 4450 SENIOR SEMINAR	1
<b>TOTAL SEMESTER HOURS</b>	<b>16</b>

FOURTH YEAR-SPRING	HOURS
BIOLOGY ELECTIVE(S)	6
FREE ELECTIVE(S)	3
SOCIAL SCIENCE ELECTIVE(S)	3
HUMANITIES ELECTIVE(S)	3
<b>TOTAL SEMESTER HOURS</b>	<b>15</b>
<b>TOTAL DEGREE REQUIREMENT HOURS</b>	<b>122</b>

\*Not required for graduation

## Important notes

<sup>1</sup>4 credit hours of Biology elective may be substituted for BIOL 1520 if a score of 5 was achieved on the AP Biology test. 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.

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

<sup>3</sup>Quantitative Biology Requirement: choose one of the following: BIOL 2400 Mathematical Models in Biology, BIOL 4150 Genomics & Applied Bioinformatics, BIOL 4401 Experimental Design & Biostatistics, BIOL 4422 Theoretical Ecology, BIOL 4755 Mathematical Biology, BIOL 4545 Human Genetics, BIOL 4803 Population Biology, MATH 3215 Probability & Statistics, MATH 3770 Statistics & Applications

<sup>4</sup>Senior Research Experience: choose one of the following: BIOL 4590 Research Project Lab, BIOL 4690 Independent Research Project, BIOL 4910 Honors Research Thesis.

## B.S. DEGREE ENHANCEMENTS

### **Bachelor of Science in Biology – Research Option**

This plan 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) in their final semester and two one credit-hour writing courses, LCC 4701 and 4702. These writing courses can be counted as Biology electives. Note that LCC 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.

### **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 taken will fulfill requirements for Biology electives, and another 3 credit hours of management courses count as free electives. Biology majors in this option must still fulfill the other requirements for the Biology undergraduate degree. Students interested in the Business Option should visit <http://www.biology.gatech.edu/undergraduate-program/current-students/advising/business.php> for specific details on the courses available.

### **Bachelor of Science in Biology - International Plan**

Georgia Tech has recently introduced 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://web.mac.com/kirkbowman1/Valencia/Valencia.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).

## **BIOLOGY MINOR AND CERTIFICATES**

### **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 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. 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 count towards the student's major and minor if the course:

1. Is not required 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. Non-Biology majors are required to include at least 9 credits of BIOL coursework for their certificate. Further information is available from School of Biology advisors.

To declare a certificate in Biology, select 12 credits that correspond to the desired certificate. Approved courses are listed at <http://www.biology.gatech.edu/undergraduate-program/current-students/minor.php> by certificate title. Students must also complete and submit a certificate application form found at this link two weeks prior to the end of their last term:

[http://www.biology.gatech.edu/undergraduate-program/current-students/docs/Biology\\_Certificate\\_Application.doc](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

BIOL 4015

BIOL 4105

Human Anatomy and Physiology

Cancer Bio/Tech

Macromolecular Modeling

BIOL 4150	Genomics & Applied Bioinformatics
BIOL 4340	Medical Microbiology
BIOL 4401	Experimental Design and Statistical Methods
BIOL 4464	Developmental Biology
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: Evolutionary Developmental Biology
BIOL 4802	Special Topics: Drug Discovery
BIOL 4803	Special Topics: Human Genetics
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 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	Special Topics: Protein Biology
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
BIOL 4803	Special Topics: Population & Evolutionary Ecology
CEE 2300	Environmental Engineering Principles
CEE 3340	Environmental Engineering Laboratory
CEE 4300	Environmental Engineering Systems
CEE 4620	Environmental Impact Assessment
CHEM/EAS 4740	Atmospheric Chemistry
EAS 1600	Intro Environmental Science
EAS 1601	Habitable Planet
EAS 2420	Environmental Measures
EAS 2600	Earth Processes
EAS 2602	Earth Through Time
EAS 4110	Resources, Energy & the Environment
EAS 4300	Oceanography
EAS 4350	Paleoclimate & Paleoceanography
EAS 4410	Climate & Global Change
EAS 4602	Biogeochemical Cycles

#### 5) Marine Science

BIOL 4221	Biological Oceanography
BIOL 4410	Microbial Ecology
BIOL 4417	Marine Ecology
BIOL 4446	Animal Physiology

BIOL 4620	Aquatic Chemical Ecology
CEE 3040	Fluid Mechanics
CEE 4225	Coastal Engineering
EAS 3620	Geochemistry
EAS 4300	Oceanography
EAS 4350	Paleoclimatology and Paleoceanography
EAS 4602	Biogeochemical cycles
NS 2323	Navigation

#### 6) Integrative Biology

12 credits chosen from courses represented in four of the other certificates (e.g., 3 credits from each of 4 other certificates = 12 credits total).

For non-Biology majors:

Additional courses that can count towards any of the above 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, and only up to 3 credits of courses at the 1xxx-2xxx level can count). For non-majors, at least 9 credits of BIOL coursework are required for each certificate.

### **ONLINE GRADUATION APPLICATION**

Biology 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 you are pursuing the Business Option, you need to select the Business Option through Oscar ([www.degreeworks.gatech.edu/images/training/concentration\\_mgt.pdf](http://www.degreeworks.gatech.edu/images/training/concentration_mgt.pdf)).

Instructions for the Online Application for Graduation (OAG)

1. Log into [degreeworks.gatech.edu](http://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 Falthrough Course.)
  - a. Take careful note of the courses you that 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. The first screen you will see is the Curriculum Selection screen. This displays your official curriculum as recognized by the Office of the Registrar. If your curriculum is incorrect, STOP. Please contact Degree Certification ([dc@lists.gatech.edu](mailto:dc@lists.gatech.edu) or 404-894-4150) immediately for assistance. The program you are applying for must match your program on record.
4. If your program is correct, then 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.

## 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:

**Chemistry** – <http://www.chemistry.gatech.edu/undergraduate/curriculum/>

**Psychology** –

<http://www.psychology.gatech.edu/undergraduate/undergraduateprograms/certificates.php>

**Management** – <http://mgt.gatech.edu/programs/under/>

**Biomedical engineering** –

[http://acad.bme.gatech.edu/undergraduate/program\\_ugrad\\_minor.php](http://acad.bme.gatech.edu/undergraduate/program_ugrad_minor.php)

**Energy Systems** – <http://www.catalog.gatech.edu/students/ugrad/minors/EnergySystems.pdf>

## 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 after hours and operate in convenient locations, such as the Freshman Residence Halls and the Chapin Building (OMED)..

**Counseling Center:** At some point you may develop a problem 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/>.

**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. 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 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.gtup.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](mailto:intern@dopp.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 at the appropriate time.

**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 by mid-March and a committee of faculty members will select the winner. Accompanying the manuscript should be a letter from the faculty mentor describing the importance of the findings, and the role the student played in the design and execution of the experiments, as well as preparation of the manuscript. It is

acceptable for the student's contribution to be part of a larger research project, but if the manuscript has multiple authors, the student's contributions must be carefully described in the mentor's letter. 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. Meetings are held monthly.

**Beta Beta 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 to local regions of biological interest.

The national, once-in-a-lifetime membership dues are \$45 for regular members or \$35 for associate members with a \$10 fee to upgrade to regular member; local dues are \$10 per year. The national dues also include a two-year subscription to the Tri-Beta quarterly publication Bios. If you are interested or would like further information about Tri-Beta at Georgia Tech, contact the faculty advisor, Dr. Yen ([jeannette.yen@biology.gatech.edu](mailto: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 medical residents. Premedical membership is open to any student who attends classes at least 20 clock hours per week and who is preparing to attend medical school. Dues are \$20 per year.

The Georgia Tech chapter of AMSA (<http://www.qtamsa.org/>) has meetings every two to three weeks throughout the school year. Guest speakers include campus premedical advisors, medical school admissions officers from Georgia medical schools, representatives of MCAT

preparation firms, and military scholarship recruiters. Every year students from the GT AMSA chapter attend regional and national AMSA meetings in such cities as Washington, Miami and San Francisco.

**American Society for Microbiology (ASM) Georgia Tech chapter:** ASM “is the oldest and largest single life science membership organization in the world” (<http://www.asm.org/>). The GA Tech ASM chapter <http://www.asm.gtorg.gatech.edu/> is a student group organized to promote the field of microbiology as both a study and a career. The group promotes interaction between students and faculty interested in microbiology, awareness of career opportunities in microbiology, and intellectual curiosity related to the field.

Meetings and events sponsored by the GA Tech ASM chapter are approximately once a month throughout the school year. Past events include: visits by guest microbiologists from campus and other institutions including 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 the national ASM meeting as well as the meeting sponsored by the Southeastern branch of ASM <http://www.asmbranches.org/brSoE/index.html>. The faculty advisor is Dr. Brian Hammer ([brian.hammer@biology.gatech.edu](mailto:brian.hammer@biology.gatech.edu)).

**Pre-Veterinary Medical Association (PVMA):** Future veterinarians at Tech work with each other to learn about pre-requisites, share advice on where to volunteer and obtain “Animal Hours,” tour animal care facilities, and fundraise for area animal-care organizations. If you would like further information, please contact the faculty advisor, Dr. Chrissy Spencer.

**Society for BioDiversity:** The Society for BioDiversity 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. For more information, contact the faculty advisor, Dr. Yuhong Fan.

## UNDERGRADUATE TEACHING IN THE SCHOOL OF BIOLOGY

The School of Biology hires Biology majors for part-time work as laboratory teaching assistants in the fall and spring semesters. These positions have several requirements and are competitive. Applicants must 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. Jobs involving preparation of materials for the teaching labs are occasionally available and also require an application. For more information, please contact Dr. Linda Green.

## UNDERGRADUATE RESEARCH IN THE SCHOOL OF BIOLOGY

Research is the most fulfilling scientific experience of many undergraduate careers 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 (see below) register for BIOL 4699. However, juniors or seniors completing their Senior Research Experience register for BIOL 4690 or 4910. BIOL 4699, 4690, and 4910 can count towards a Biology major's program of study; up to 6 credits of BIOL 4699 can count as Biology electives. Additional BIOL 4699 credits count as free electives. The faculty mentor must provide permission for a student to register for any of the research classes by emailing Benita Black (include student name and GT ID#). Each credit hour registered represents approximately 3 hours per week of research effort for a semester.

**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 Benita Black (include student name and GT ID#).

**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 can conduct research in other Schools within Georgia Tech or even in institutions outside of Georgia Tech, and obtain credit for 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). In this case, 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). Note that a co-supervisor is not needed if the faculty mentor has a minor or courtesy appointment within the School of Biology.

To conduct research outside 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 then needs to have a confirmation email sent from the primary research mentor saying that they are willing to serve as a research mentor, follow the Biology syllabus for the course in question, and provide the final 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>). BIOL 4690 and 4910 are conducted under the supervision of a faculty member in the research laboratory. BIOL 4590 is taught by Biology faculty members each semester in various areas of Biology chosen by the faculty teaching the course. All three courses require that students produce certain deliverables as outlined in the syllabi for the courses available from the School of Biology website or the course mentors or professors. 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 permission 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> 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/>). The awards can be made for student salaries, travel expenses, or supplies. Students must also be registered for BIOL 2698, 2699, 4698, 4699, 4690, or 4910 when they have a PURA.

**Biology Research Courses:** See <http://www.biology.gatech.edu/undergraduate-program/current-students/syllabi/> for syllabi.

BIOL 2698 – Research Assistantship: Independent research conducted under the guidance of a faculty member. 1-12 credit hours. Audit-only class.

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 the class to receive a permit. Letter grade must be sent by the faculty mentor to the instructor of record of BIOL 4690 for the semester in question.

BIOL 4698 – Research Assistantship: Independent research conducted under the guidance of a faculty member. 1-12 credit hours. Audit-only course.

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 an Undergraduate Research

Thesis describing research accomplishments 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 must be 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. It should correspond 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. 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 his/her 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.

Some quotes from students demonstrating the importance of research experience:

"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.”

## **GETTING LETTERS OF RECOMMENDATION**

To get a job or to get into graduate or professional school, you will need letters of recommendation from the faculty. 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. You will likely need at least three letters of reference, so start developing relationships with faculty as soon as possible.

*What can letters of recommendation do for you?*

They can point out features of your record, habits, or personality that are important in hiring and admission decisions. They can get you a job or admission to graduate or professional program when your grades are not as high as those of other candidates.

*What would a good letter of recommendation say?*

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.

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.

*Who should write your letters of recommendation?*

Someone who can provide the kind of information described above.

*How do you find someone like that?*

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, 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.

*What is your part of the task?*

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 addresses, and typed 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: conflicts may occur when people work closely together and 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>.

## **ADVICE FROM FORMER 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 website frequently for summer jobs, seminars, and research opportunities. You should attend several Biology seminars 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 for the test.

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.

## RESEARCH FACULTY

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/>). Details and contact information for specific faculty can be found at <http://www.biology.gatech.edu/people/faculty.php> and through the personal websites of individual faculty members.

## ACADEMIC PROFESSIONALS AND INSTRUCTORS

The academic professionals and instructors within the School of Biology will often be your primary contacts for discussing your degree and career plans. Contact information for academic professionals and instructors can be found at <http://www.biology.gatech.edu/people/faculty.php>.

### BIOLOGY COURSE LISTINGS

#### **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 Prin**

An advanced introduction to the 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

Prerequisites: Biology 4 or IB Biology 4 or Undergraduate Semester level BIOL 1520 Minimum Grade of B or Undergraduate Semester level BIOL 1521 Minimum Grade of B

#### **BIOL 1520 - Intro to Organismal Biol**

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 Biol**

Introduction to biology at the organ and organismal levels, with emphasis on biodiversity, physiological processes, and integration of growth, reproduction and development. 4.000 Credit hours, 3.000 Lecture hours, 3.000 Lab hours

Prerequisites: Biology 4 or IB Biology 4 or Undergraduate Semester level BIOL 1510 Minimum Grade of B or Undergraduate Semester level BIOL 1511 Minimum Grade of B

#### **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: Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D

#### **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. 0

1.000 Credit hours, 0.000 Lecture hours, 3.000 Lab hours

Corequisites: BIOL 2335

Prerequisites: Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D

### **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:Undergraduate Semester level BIOL 1510 Minimum Grade of B or Undergraduate Semester level 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:Undergraduate Semester level BIOL 1510 Minimum Grade of B or Undergraduate Semester level 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:Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D

### **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:Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D

### **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:(Undergraduate Semester level BIOL 1510 Minimum Grade of B or Undergraduate Semester level 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:Undergraduate Semester level BIOL 1510 Minimum Grade of B or Undergraduate Semester level BIOL 1511 Minimum Grade of B

### **BIOL 2400 - Math Models in Biol**

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:(Undergraduate Semester level MATH 1502 Minimum Grade of D or Undergraduate Semester level MATH 1512 Minimum Grade of D or Undergraduate Semester level MATH 1522 Minimum Grade of D) and (Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D)

**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&Evol-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:Undergraduate Semester level BIOL 2100 Minimum Grade of D

**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:Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D

**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:(Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D) and Undergraduate Semester level CHEM 2311 Minimum Grade of D

**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:(Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D) and Undergraduate Semester level CHEM 2311 Minimum Grade of D

**BIOL 3450 - Cell Molecular Biol**

An introduction to the structure and function of cells and their organelles with emphasis on eucaryotic cellular and molecular processes.

3.000 Credit hours, 3.000 Lecture hours

Prerequisites:(Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D) and (Undergraduate Semester level CHEM 2311 Minimum Grade of D or Undergraduate Semester level CHEM 1315 Minimum Grade of D)

### **BIOL 3451 - Cell Molecular Biol 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:(Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D) and (Undergraduate Semester level CHEM 2311 Minimum Grade of D or Undergraduate Semester level CHEM 1315 Minimum Grade of D)

### **BIOL 3600 - Intro Evolutionary Biol**

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:Undergraduate Semester level BIOL 2344 Minimum Grade of D or Undergraduate Semester level BIOL 2354 Minimum Grade of D and (Undergraduate Semester level BIOL 2335 Minimum Grade of D or Undergraduate Semester level BIOL 2337 Minimum Grade of D)

### **BIOL 3751 - Anatomy & Physiology**

Study of human anatomy and fundamental physiological mechanisms. Topics include nervous, musculoskeletal, and cardiorespiratory systems. Free elective for biology majors. Crosslisted with AP 3751.

3.000 Credit hours, 3.000 Lecture hours

Prerequisites:Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D or Undergraduate Semester level CHEM 1310 Minimum Grade of D

### **BIOL 3753 - 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

Prerequisites:BIOL 1520 or BIOL 1521 or CHEM 1211K or CHEM 1310 Minimum Grade of D

### **BIOL 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.

1.000 Credit hours, 0.000 Lecture hours, 3.000 Lab hours

Corequisites:APPH 3753 or BIOL 3753

### **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 4015 - Cancer Bio/Tech**

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: Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D or Undergraduate Semester level BIOL 1520 Minimum Grade of D or Undergraduate Semester level BIOL 1521 Minimum Grade of D or Undergraduate Semester level CHEM 1310 Minimum Grade of D or Undergraduate Semester level CHEM 1211K Minimum Grade of D or Undergraduate Semester level CHEM 1212K Minimum Grade of D or Undergraduate Semester level PHYS 2211 Minimum Grade of D or Undergraduate Semester level PHYS 2212 Minimum Grade of D or Undergraduate Semester level EAS 1600 Minimum Grade of D or Undergraduate Semester level EAS 1601 Minimum Grade of D or Undergraduate Semester level EAS 2600 Minimum Grade of D

### **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: Undergraduate Semester level BIOL 2335 Minimum Grade of D or Undergraduate Semester level BIOL 2337 Minimum Grade of D

### **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&Appl Bioinfor**

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: Undergraduate Semester level BIOL 2344 Minimum Grade of D or Undergraduate Semester level BIOL 2354 Minimum Grade of D and (Undergraduate Semester level CS 1321 Minimum Grade of D or Undergraduate Semester level CS 1371 Minimum Grade of D or Undergraduate Semester level CS 1301 Minimum Grade of D or Undergraduate Semester level CS 1315 Minimum Grade of D)

### **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: Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D

### **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: Undergraduate Semester level BIOL 3600 Minimum Grade of D

### **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: Undergraduate Semester level BIOL 3380 Minimum Grade of D

### **BIOL 4401 - Exper Dgn&Statis 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: Undergraduate Semester level MATH 1502 Minimum Grade of D or Undergraduate Semester level MATH 1512 Minimum Grade of D or Undergraduate Semester level MATH 1522 Minimum Grade of D and (Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D)

### **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: Undergraduate Semester level BIOL 3380 Minimum Grade of D

### **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: Undergraduate Semester level BIOL 2335 Minimum Grade of D or Undergraduate Semester level BIOL 2337 Minimum Grade of D

### **BIOL 4418 - Microbial Physiology**

Study of the physiology of growth and metabolic activities of microorganisms.

3.000 Credit hours, 3.000 Lecture hours

Prerequisites: Undergraduate Semester level BIOL 3380 Minimum Grade of D and Undergraduate Semester level BIOL 3450 Minimum Grade of D

### **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: Undergraduate Semester level MATH 2403 Minimum Grade of D or Undergraduate Semester level BIOL 2400 Minimum Grade of D

### **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: Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D and Undergraduate Semester level BIOL 1520 Minimum Grade of D or Undergraduate Semester level BIOL 1521 Minimum Grade of D

### **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: Undergraduate Semester level BIOL 3450 Minimum Grade of D

### **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: Undergraduate Semester level BIOL 4590 Minimum Grade of D or Undergraduate Semester level BIOL 4690 Minimum Grade of D or Undergraduate Semester level BIOL 4910 Minimum Grade of D

### **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: (Undergraduate Semester level BIOL 2344 Minimum Grade of D or Undergraduate Semester level BIOL 2354 Minimum Grade of D) and Undergraduate Semester level BIOL 3450 Minimum Grade of D

### **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: (Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level MATH 1511 Minimum Grade of D) and (Undergraduate Semester level MATH 1502 Minimum Grade of D or Undergraduate Semester level MATH 1512 Minimum Grade of D or Undergraduate Semester level MATH 15X2 Minimum Grade of D) and Undergraduate Semester level PHYS 2212 Minimum Grade of D

### **BIOL 4478 - Biophysics**

Biophysical aspects of nucleic acids, proteins, and their interactions.

3.000 Credit hours, 3.000 Lecture hours

Prerequisites: Undergraduate Semester level PHYS 2211 Minimum Grade of D and (Undergraduate Semester level BIOL 2344 Minimum Grade of D or Undergraduate Semester level BIOL 2354 Minimum Grade of D or Undergraduate Semester level BIOL 3450 Minimum Grade of D)

### **BIOL 4480 - Evolution-Develop Biol**

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: Undergraduate Semester level BIOL 3600 Minimum Grade of D

### **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: Graduate Semester level BIOL 2344 Minimum Grade of D or Undergraduate Semester level BIOL 2345 Minimum Grade of D

### **BIOL 4570 - Immunology & Immunochem**

A survey of modern immunology and its applications.

3.000 Credit hours, 3.000 Lecture hours

Prerequisites: Undergraduate Semester level BIOL 3450 Minimum Grade of D and (Undergraduate Semester level BIOL 2344 Minimum Grade of D or Undergraduate Semester level BIOL 2354 Minimum Grade of D)

**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:Undergraduate Semester level BIOL 1510 Minimum Grade of D

**BIOL 4608 - Prokaryotic Mole 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:Undergraduate Semester level BIOL 2344 Minimum Grade of D or Undergraduate Semester level BIOL 2354 Minimum Grade of D

**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:Undergraduate Semester level BIOL 2335 Minimum Grade of D or Undergraduate Semester level BIOL 2337 Minimum Grade of D

**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:Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D

**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:Undergraduate Semester level BIOL 2344 Minimum Grade of D or Undergraduate Semester level BIOL 2354 Minimum Grade of D

**BIOL 4690 - Independnt Research Proj**

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:Undergraduate Semester level BIOL 2698 Minimum Grade of D or Undergraduate Semester level BIOL 2699 Minimum Grade of D or Undergraduate Semester level BIOL 4698 Minimum Grade of D or Undergraduate Semester level BIOL 4699 Minimum Grade of D

**BIOL 4696 - Biol Teaching Assistant**

Biology teaching carried out under the guidance of a faculty member.

3.000 Credit hours, 3.000 Lecture hours

Prerequisites:Undergraduate Semester level CETL 2000 Minimum Grade of D

**BIOL 4697 - Biol Undergrad 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.

0.000 OR 3.000 Credit hours, 0.000 OR 1.000 Lecture hours, 0.000 OR 6.000 Lab hours

Prerequisites: Undergraduate Semester level CETL 2000 Minimum Grade of D

### **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: Undergraduate Semester level BIOL 1520 Minimum Grade of D or Undergraduate Semester level BIOL 1521 Minimum Grade of D or Undergraduate Semester level BIOL 3600 Minimum Grade of D or Undergraduate Semester level BMED 3100 Minimum Grade of D or Undergraduate Semester level PHYS 2211 Minimum Grade of D

### **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: Undergraduate Semester level BIOL 1510 Minimum Grade of D or Undergraduate Semester level BIOL 1511 Minimum Grade of D and Undergraduate Semester level CHEM 2311 Minimum Grade of D

### **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: Undergraduate Semester level BIOL 3450 Minimum Grade of D or Undergraduate Semester level BMED 3160 Minimum Grade of D

### **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: Undergraduate Semester level MATH 2403 Minimum Grade of D or Undergraduate Semester level BIOL 2400 Minimum Grade of D

### **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:(Undergraduate Semester level BIOL 2698 Minimum Grade of D or Undergraduate Semester level BIOL 2699 Minimum Grade of D) or Undergraduate Semester level BIOL 4698 Minimum Grade of D or Undergraduate Semester level BIOL 4699 Minimum Grade of D

**COURSES FROM OTHER SCHOOLS 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

## STUDENT/ADVISOR WORK SHEET 2013-2014

Student Name: \_\_\_\_\_ ID number: \_\_\_\_\_

A. General Biology (Required)	Credits	✓	C. Other Required Courses	Credits	✓
Biol 1510 or 1511 Biol Princ	4		Chem 1211K Chem Princ I	4	
Biol 1520 or 1521 Organ Bio	4		Chem 1212K Chem Princ II	4	
Biol 2335 or 2337 Ecology	3		Math 1501 Calculus I	4	
Biol 2344 or 2354 Genetics	3		Math 1502 Calculus II	4	
Biol 3600 Evolution	3		Chem 2311 Organic Chem I	3	
Biol 3450 Cell & Molecular Bio	3		Chem 2312 Organic Chem II	3	
Biol 4450 Senior Seminar	1		Chem 2380 Synthesis Lab	2	
<b>Choose 2 from:</b>			Phys 2211/2501 Physics I	4	
Biol 2336 or 2338 Ecology Lab	1		Phys 2212/2502 Physics II	4	
Biol 2345 or 2355 Genetics Lab	1		CS 1301 or 1315 or 1371	3	
Biol 3451 Cell & Molec Bio Lab	1		APPH 1040 or 1050 Wellness	2	
<b>Choose 1 from:</b>			<b>Total</b>	<b>37</b>	
Biol 2400 Math Models Bio	3				
Biol 4150 Genomics & App Binf	3				
Biol 4401 Exp Des and Stat	3				
Biol 4422 Theoretical Ecol	3				
Biol 4545 Human Genetics	3				
Biol 4755 Mathematical Bio	3				
Biol 4803 Population Biology	3		<b>D.-E. Social Sciences/Humanities</b>	<b>Credits</b>	<b>✓</b>
Math 3770 Stats and Apps	3		History/Political Science	3	
Math 3215 Prob and Stats	3		Social Science	3	
<b>Choose 1 from:</b>			Social Science	3	
Biol 4590 Research Project Lab	3		Social Science	3	
Biol 4690 Ind. Research Proj	3		<b>Total</b>	<b>12</b>	
Biol 4910 Honors Res Thesis	3				
<b>Total</b>	<b>29</b>		English 1101	3	
			English 1102	3	
			Humanities	3	
			Humanities	3	
<b>B. Biology Electives (21 hrs req)</b>	<b>Credits</b>	<b>✓</b>			
			<b>Total</b>	<b>12</b>	
			<b>F. Free Electives</b>	<b>Credits</b>	<b>✓</b>
			GT1000 (recommended)	1	
			<b>Total</b>	<b>11</b>	
<b>Total</b>	<b>21</b>		<b>Total for Graduation</b>	<b>122</b>	