I. Program of Study

The program in Biotechnology offers a Master of Science degree. At the time of admission into the Biotechnology program, all students are subject to the requirements listed in the Texas Tech University Health Sciences Center Student Handbook (Code of Professional and Academic Conduct), the Graduate School of Biomedical Sciences Catalog, as well as the guidelines given below.

II. MS Program

A. Prerequisites for Admission: See the GSBS website for a complete list of admission requirements: www.ttuhsc.edu/gsbs

1. A bachelor's degree or the equivalent from an accredited college or university.
2. The applicants’ undergraduate record including grade point average (based on 4.0 system) will be considered as part of the overall application.
3. Each student must take the Graduate Record Examination (General Test).
4. Two letters of recommendation, which must be from former faculty or administrators who are familiar with the scholastic and research abilities of the applicant.
5. A personal interview may be requested.

B. Program Mandates

- All students are required to take four core curriculum courses, 6 hours of research, and other biotechnology and elective courses for a total of 36 hours.
- Although only 6 credit hours of research count toward the 36 total, at least 9 months of research is required.
- In the Spring semester of the first year of study, students will conduct interviews with faculty, companies, or regulatory agencies to determine where students will complete their research for the second year of the program.

C. Graduate Student Checklist (Appendix 1)

D. Sequence of Events Upon Entering the Program
1. **Introductions** - All new graduate students will meet with the Biotechnology Program Directors, the Graduate Program Advisors (Appendix 2) to chart out first year laboratory rotations and first year curriculum.

2. **Laboratory Rotations** – Lab rotations in the Spring semester of the first year curriculum are also required (GSBS 5337 – Techniques in Biotechnology). Attendance at the Fall Student/Faculty retreat is required. Students should ascertain the potential for laboratory rotations and the possibility of a faculty member becoming a mentor at this time (Appendix 3). Students will submit their requests for rotations for the Spring semester and confirm this plan with their Graduate Advisor before the end of the Fall semester (Appendix 4). The laboratory rotation is expected to be 8-12 weeks in duration. Each faculty member involved will submit a written evaluation for each rotation that must be reviewed with the student. A final rotation grade will be assigned based on a rubric (Appendix 5). The signed form will be included in the student’s program file folder.

3. **Program Curriculum**

   **FIRST YEAR CURRICULUM**

   **FALL SEMESTER:** All new biotechnology students are required to take core courses I-V.

   - **GSBS 5471 — CORE I: MOLECULES** – This course offers a broad coverage of biochemistry with an emphasis on structure and function of macromolecules, biosynthesis of small molecule precursors of macromolecules, and the pathways of intermediary metabolism.

   - **GSBS 5372 — CORE II: CELLS** – The structure/function relationships that underlie basic cellular processes, including translation protein trafficking, cytoskeletal organization and motility, cell adhesion, and cell division.

   - **GSBS 5373 — CORE III: GENES** – Teaches essential scientific concepts underlying the field of Molecular biology and Molecular Genetics.

   - **GSBS 5174 – CORE IV: BIOMEDICAL SEMINAR** – Students will attend and participate in seminars.

   - **GBTC 5120 — LABORATORY METHODS**– students learn common biotechnology techniques by completing a project to mutagenize a gene and produce protein for crystallization.

   **SPRING SEMESTER:**

   - **GBTC 6101 Biotechnology Seminar** - Students are required to attend all seminars sponsored by the Biotechnology Program. Students will present a seminar in their first year and a final seminar at the end of their internship (Spring semester) of the second year. Deviation from the yearly seminar presentation requirement requires approval of the Biotechnology graduate program committee.
2. GBTC 6301 Introduction to Biotechnology – Broad coverage of topics with high current interest and utility to the medical and agricultural biotechnology industries. Emphasizes application of technologies.

3. GBTC 6202 Biomedical Informatics - Provides a broad introduction to the field of bioinformatics in medical research. Emphasizes use of modern software packages and internet-based genomic and other databases to solve research problems. Personal laptop required – must meet the School of Medicine laptop specifications.

4. GSBS 5101 Responsible Conduct of Research – Addresses the regulatory and ethical environment of today’s biomedical research as well as such topics as authorship and data management.

5. GBTC 5337 Techniques in Biotechnology Research – Through rotations in the laboratories of Biotechnology graduate concentration faculty members, standard experimental techniques used in Biotechnology are explored through a series of hands-on laboratory exercises. The objective of lab rotations are two-fold: (1) allows the student to choose a faculty member in which to conduct his/her masters; (2) allows the student to learn multiple experimental techniques and approaches.

6. Electives (total of at least 3 credits)

**SUMMER SEMESTER:**

1. GBTC 7000 (6) – Research or GBTC 6001 (6) – Biotechnology Internship

2. Elective (optional) (3 hours) - (i.e. Business course, Intellectual Property law course, etc.)
   - Executive MBA
   - OR Mini-laboratory internship (academic or corporate)
   - OR Begin 12 month internship (academic or corporate)

**SECOND YEAR CURRICULUM**

Year 2 Internship:

**FALL SEMESTER (LAB OPTION)**

1. GBTC 7000 (9) – Research
2. GBTC 5199 – Biotechnology Lab Report
3. Elective (Optional)

**SPRING SEMESTER (LAB OPTION)**

1. GBTC 7000 (9) – Research
2. GBTC 5199 – Biotechnology Lab Report
3. Elective (Optional)

**FALL SEMESTER (INDUSTRY OPTION)**
1. GBTC 6001 (9) – Biotechnology Internship
2. GBTC 5299 – Biotechnology Industry Report

**SPRING SEMESTER (INDUSTRY OPTION)**
1. GBTC 6001 (9) – Biotechnology Internship
2. GBTC 5299 – Biotechnology Industry Report

4. **Major Advisor and Advisory Committee** – The Biotechnology Program Director and Co-Director will serve as major advisors for the biotechnology graduate students. The Biotechnology Graduate Program Committee will serve as the Advisory Committee to oversee student performance. If a student elects to do an internship at a TTUHSC laboratory, the Head of that laboratory will assume the role of Major Advisor after approval from the Biotechnology Program Director. The responsibilities of the Major Advisor are to: 1) monitor the progress of the student's research, and 2) establish and maintain financial support for the student to complete his/her research project.

5. **Assessment of Graduate Student Progress (Appendix 1):**

The Graduate Student Checklist is the major tool for assessing Graduate Student Progress through the degree program. It is the student’s responsibility to ensure that all appropriate forms are signed and filed with the Graduate Program Coordinator according to deadlines. The Assessment of Graduate Student Progress form and the student’s file will be reviewed at the end of the 1st year (May) and again in April of year two by the Program Graduate Committee and summarized on the Annual Graduate Student Progress Review form (Appendix 6). In addition to meeting the Program requirements detailed below it is expected that the student will maintain above average ratings in all required assessment tools (Appendix 1). Failure to maintain these standards may result in the student being placed on academic probation or dismissed from the program.

6. **Qualifying Exam** – Students in the Biotechnology Program do NOT take a Qualifying exam.

7. **Completion of the degree program:**

   **A) Non-Thesis Option:**

GSBS requires a minimum of 36 hours of graduate course work, and must include 6 hours of research.

All didactic class work should be completed by the start of the second year (Appendix 1). The remainder of the student’s tenure in the program is to be spent conducting and presenting their research or internship experience.

**Intent to Graduate** – A student planning to graduate must file in the GSBS office the Statement of Intent to Graduate at the beginning of the semester of intended graduation. Students should check the GSBS website for graduation deadlines at:

http://www.ttuhsc.edu/gsbs/current/.
Final Written and Oral Report: While students that select the Non-Thesis Option are not required to write and orally defend a MS thesis, the program does require submission of a final written report that should take the form of a peer-reviewable manuscript from a scientific journal of your choosing and which contains the applicant’s research and a oral defense of this manuscript.

B) Thesis Option:

GSBS requires a minimum of 36 hours of graduate course work, which must include 6 hours of research plus 6 hours of thesis.

All didactic class work should be completed by the start of the second year (Appendix 1). The remainder of the student’s tenure in the program is to be spent conducting, publishing and presenting their research.

Intent to Graduate – A student planning to graduate must file in the GSBS office the Statement of Intent to Graduate at the beginning of the semester of intended graduation. Students should check the GSBS website at: http://www.ttuhsc.edu/gsbs/current/ for the graduation deadline dates.

Final Oral Report - Once the committee agrees that the research is complete plans, for the writing and defending a student’s thesis should be made (Appendix 7). A draft of the thesis and an abstract must be submitted to the Advisory Committee at least two weeks prior to the final oral examination.

Thesis Defense – Students defend their thesis in a final public seminar followed by a private oral examination by their Advisory Committee. The written thesis must be submitted to the Advisory Committee two weeks prior to the Defense date. Evaluation of the defense and determination of its outcome is documented by the Advisory Committee and reviewed with the student. The results of the defense are recorded on the Thesis Oral Defense form and the Thesis Signature form.

Thesis Bound Copies – Students are required to purchase one bound copy through a bindery (GSBS recommends using thesisondemand.com). Student advisory committee members may also request that the student provide them with a bound copy. The program requires only submission of a .pdf copy of the final version to the graduate program coordinator.

III. Expectations For Continuation in the Biotechnology program and Appeals Following Dismissal

The Biotechnology program will follow all GSBS policies and procedures. Additional details on the following are available in the GSBS catalog: http://www.ttuhsc.edu/gsbs/

A. Continuation in the Program

Every student enrolled is required to maintain a high level of performance and to comply fully with policies of TTUHSC, GSBS and the Biotechnology Program. The Graduate School of Biomedical Sciences reserves the right to place on probation or to dismiss any graduate student who does not
maintain satisfactory academic standing or who fails to conform to the regulations. Students who are conditionally admitted to a degree program are automatically on probation. Failure to fulfill the conditions stipulated at the time of admission will result in dismissal from the program.

Every student is expected to maintain a high level of commitment to professional development in a variety of areas. If any aspect of a student's professional development (for example attention to teaching responsibilities, appropriate growth toward development of critical thinking skills or appropriate progress toward research goals, etc.) is considered to be unsatisfactory by the Biotechnology Program Graduate Committee, the student shall be so informed in writing, along with a description of the recommended corrective action and the period of time allowed for the corrective action to be taken. If the student fails to correct the deficiency, the committee may recommend dismissal of the student from the program.

If a student's graduate GPA for a particular semester falls below 3.0, the student will be placed on academic probation. The student must make a 3.0 GPA or better in each succeeding semester, will result in academic dismissal from GSBS. Regulations governing scholastic probation are based on semester grade-point averages and will be applied regardless of overall grade-point average.

B. Appeals and Grievance Process

Student Appeals Policy. This policy applies to specific grievances arising from matters affecting students' academic standing and performance, such as disputes concerning comprehensive examinations and graduate assistantships. Appeals may be made only when alleged prejudicial, arbitrary or capricious action is involved. The burden of proof of unfair influence or action rests with the student.

A student wishing to appeal a decision or action first should discuss the matter with the faculty member or members involved. If the student is not satisfied with the outcome of this effort, the student should contact the Program Director. This contact, like that with the faculty members, normally is informal, and the Program Director may take whatever action he or she deems advisable in attempting to resolve the issue. All parties involved should make every effort to resolve the issue without going beyond this level. The Program Director may consult with either the Biotechnology Program Graduate Committee or an ad hoc committee of graduate faculty from the Program (when the appeal is of an action taken by the Graduate Committee or a substantial proportion of its elected members) for advice regarding his actions in an appeal. If the student still is not satisfied following these meetings and discussions, the student may make a formal appeal to the Dean for the Graduate School of Biomedical Sciences. The appeal shall be processed according to the rules of the Graduate School in effect at the time it is filed with the GSBS Dean.

IV. Scholarships and Research Assistantships

Students admitted into the Biotechnology program will receive scholarships for the first year for both the Fall and Spring semesters. Beginning in the summer term, if a student chooses to stay in a Biotechnology faculty lab, research assistantships will be available (½ paid by GSBS, ½ paid by investigator) through the completion of the program (given that students are in good academic standing). RA positions are by application, starting June 1st and ending on the day of graduation.
APPENDIX 1: Student Checklist

Biotechnology
Student Checklist

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Date Completed</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Required Courses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GSBS 5471 CORE I: Molecules</td>
<td></td>
<td></td>
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<tr>
<td>GSBS 5372 CORE II: Cells</td>
<td></td>
<td></td>
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<tr>
<td>GSBS 5373 CORE III: Genes</td>
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<td></td>
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<tr>
<td>GSBS 5174 CORE IV: Biomedical Seminar Series</td>
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<tr>
<td>GBTC 5120 Laboratory Methods</td>
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<tr>
<td>GBTC 6301 Introduction to Biotechnology</td>
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<tr>
<td>GBTC 6101 Seminar</td>
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<tr>
<td>GBTC 6202 Biomedical Informatics</td>
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<tr>
<td>GSBS 5101 Responsible Conduct of Research</td>
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<td></td>
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<tr>
<td>GBTC 5337 Techniques in Biotechnology Research</td>
<td></td>
<td></td>
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<tr>
<td>Elective:______________________________________</td>
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<td></td>
</tr>
<tr>
<td>Elective:____________________ (3 crs)</td>
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<td></td>
</tr>
<tr>
<td>Year 2, GBTC 5199 or GBTC 5299 (Fall)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 2, GBTC 5199 or GBTC 5299 (Spring) (final presentation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>GBTC 7000 Research or GBTC 6001 Internship (24 hours)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interviews with companies, agencies and faculty completed no later than May of the first year.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Internship Selection</strong> following interviews.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submit Degree Program to GSBS during Spring semester of first year.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Submit Intent to Graduate to GSBS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>See checklist for graduation deadlines from the GSBS website.</td>
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<td></td>
</tr>
</tbody>
</table>

Appendix 2: Current Committee Assignments
Biotechnology Graduate Program (other??) Committee:

Susan Bergeson  Program Director
Ted Reid       Program Co-Director/Graduate Advisor - Lubbock
Irene La-Beck  Graduate Program Advisor - Abilene
Tracy Cowin    Graduate Program Coordinator - Lubbock
Talia Jaryszak Graduate Program Coordinator - Abilene
Michael Blanton  Ex-Officio
Kendra Rumbaugh
Ina Urbatsch

Graduate Council Representatives:

Irene LaBeck
Kendra Rumbaugh
Appendix 3
Graduate Faculty of the Biotechnology Program

Susan Bergeson, Ph.D. (Program Director)
Ted Reid, Ph.D. (Program Co-Director/Graduate Advisor)
Irene La-Beck, Pharm.D. (Program Co-Director/Graduate Advisor)
Guillermo Altenberg, Ph.D.
Michael Blanton, Ph.D.
Robert Bright, Ph.D.
Michael Conn, Ph.D.
Gail Cornwall, Ph.D.
Jannette Dufour, Ph.D.
Stephanie Filleur, Ph.D.
Joe Fralick, Ph.D.
Vadivel Ganapathy, Ph.D.
Matthew Grisham, Ph.D.
Petar Grozdanov, Ph.D.
Lan Guan, MD, Ph.D.
Josee Guindon, DVM, Ph.D.
Abdul Hamood, Ph.D.
Daniel M. Hardy, Ph.D.
Michaela Jansen, Ph.D.
Min Kang, Ph.D.
Magdalena Karbowniczek, MD, Ph.D.

John Lawrence, Ph.D.
Henry Lui, Ph.D.
Devin Lowe, Ph.D.
Clinton C. MacDonald, Ph.D.
Maciej Markiewski, MD, Ph.D.
Pratip Mitra, Ph.D.
Volker Neugebauer, Ph.D.
Samuel Prien, Ph.D.
Kevin Pruitt, Ph.D.
Hemachandra Reddy, Ph.D.
Patrick Reynolds, MD, Ph.D.
Kendra Rumbaugh, Ph.D.
Brandt Schneider, Ph.D.
Souad Sennoune, Ph.D.
Afzal Siddiqui, Ph.D.
Bryan Sutton, Ph.D.
Peter Syapin, Ph.D.
Jeffrey Thomas, Ph.D.
Vijay Tonk, Ph.D.
Ina Urbatsch, Ph.D.
Simon C. Williams, Ph.D.
Laurence Wood, Ph.D.
Appendix 4: Laboratory Rotation Schedule

To: The Graduate Advisor of the Biotechnology Program

From: Graduate Student

Subject: Schedule for laboratory rotations

Date: 

<table>
<thead>
<tr>
<th>Faculty Member</th>
<th>Time Period (8-12 weeks)</th>
<th>Purpose of Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Potential Experience</td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The faculty member must agree upon rotation choices.

Date Reviewed by Graduate Program Advisor:

________________________________________
Appendix 5: Evaluation of graduate students during laboratory rotations.

Biotechnology Graduate Program
Rubric for laboratory rotations

Student Name: ____________________________ Rotation Date: ______________________

Circle either YES or NO for each question. NO requires an explanation

1. Student understands the rationale of the research focus of the lab.
   YES NO (explanation):

2. Student demonstrates sufficient experimental attention to detail.
   YES NO (explanation):

3. Student learns the principles of methods used for experiments.
   YES NO (explanation):

4. Student learns to interpret data independently and accurately.
   YES NO (explanation):

5. Student demonstrates capacity to plan appropriate experiments.
   YES NO (explanation):

6. Student maintains a legible record of experimental details.
   YES NO (explanation):

7. Student demonstrates progressively increasing independence.
   YES NO (explanation):

8. Student was in the laboratory an average of six hours per week.
   YES NO (explanation):

**Final Grade (circle one):**

If six or more ‘YES’: A

If three or four ‘NO’: B

If five or more ‘NO’: C

**ADDITIONAL COMMENTS:** (If additional space is needed continue on the back)

Date evaluation reviewed by Graduate Advisor _________________
Appendix 6: Annual Graduate Student Progress Review

Student Name: ____________________________

Program Committee
Review Date: __________________________

Comments: ________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Committee Members:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Graduate Advisor Signature: ____________________________
APPENDIX 7: Final Oral Report

This form should be completed and filed in the student's official departmental record following agreement by the student's graduate committee that all necessary "benchwork" has been completed for the thesis. Committee members are urged to strongly consider a student's track record of productivity as judged by peer-reviewed publications or presentations at meetings. No more than one negative vote can be cast in this regard. This is a major "turning point" in the students training. It signifies the time at which the student should stop doing experiments and begin writing his/her thesis. Use additional pages if necessary.

Students must submit this form to the graduate program coordinator each year in May as part of the graduate program committee student progress evaluation process. Committee signatures are not required for the yearly submission.

Date: ____________________________

Student: ____________________________

List of abstracts, publications, presentations, awards, and/or graduate fellowships:

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

Committee Members

____________________________________________________________________  In favor  Against

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

Reviewed by Graduate Advisor: Date: ____________________________
Appendix 8
Required Courses

**Year 1, Fall Term**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>GSBS 5471</td>
<td>Core I: Molecules</td>
<td>4</td>
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<td>GSBS 5372</td>
<td>Core II: Cells</td>
<td>3</td>
</tr>
<tr>
<td>GSBS 5373</td>
<td>Core III: Genes</td>
<td>3</td>
</tr>
<tr>
<td>GSBS 5174</td>
<td>Core IV: Biomedical Seminar</td>
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</tr>
<tr>
<td>GBTC 5120</td>
<td>Laboratory Methods</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
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**Year 1, Spring Term**

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<th>Course Name</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>GBTC 6101</td>
<td>Biotechnology Seminar</td>
<td>1</td>
</tr>
<tr>
<td>GBTC 5337</td>
<td>Techniques in Biotechnology Research</td>
<td>3</td>
</tr>
<tr>
<td>GBTC 6301</td>
<td>Introduction to Biotechnology</td>
<td>3</td>
</tr>
<tr>
<td>GBTC 6202</td>
<td>Biomedical Informatics</td>
<td>2</td>
</tr>
<tr>
<td>GSBS 5101</td>
<td>Responsible Conduct of Research</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Elective (Optional*)</td>
<td>3</td>
</tr>
<tr>
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**Year 1, Summer Term**

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<th>Course Name</th>
<th>Credit Hours</th>
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<tr>
<td>GBTC 7000 or</td>
<td>Research OR</td>
<td>6</td>
</tr>
<tr>
<td>GBTC 6001</td>
<td>Internship</td>
<td></td>
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<tr>
<td></td>
<td>Elective (Optional*)</td>
<td>3</td>
</tr>
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<td></td>
<td><strong>Total</strong></td>
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**Year 2, Fall Term**

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<th>Course Name</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>GBTC 7000 or</td>
<td>Research OR</td>
<td>9</td>
</tr>
<tr>
<td>GBTC 6001</td>
<td>Internship</td>
<td>9</td>
</tr>
<tr>
<td>GBTC 5199 or</td>
<td>Biotechnology Lab Report</td>
<td>1</td>
</tr>
<tr>
<td>GBTC 5299</td>
<td>Biotechnology Industry Report</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Elective (Optional*)</td>
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<td></td>
<td><strong>Total</strong></td>
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**Year 2, Spring Term**

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<tbody>
<tr>
<td>GBTC 7000 or</td>
<td>Research OR</td>
<td>9</td>
</tr>
<tr>
<td>GBTC 6001</td>
<td>Internship</td>
<td>9</td>
</tr>
<tr>
<td>GBTC 5199 or</td>
<td>Biotechnology Lab Report</td>
<td>1</td>
</tr>
<tr>
<td>GBTC 5299</td>
<td>Biotechnology Industry Report</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Electives (Optional*)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>10 or 14</strong></td>
</tr>
</tbody>
</table>

*Students must take 2 electives, but can be taken at any point in the degree plan. A total of 5 credit hours must be taken*