

# BIOTECHNOLOGY B.S./M.S. (4 +1)

## Overview

### Master of Science in Biotechnology

The 4+1 BS/MS program is a combined Biotechnology BS major/ Biotechnology MS degree that students complete in 5 years.

The Biotechnology degree is geared for those seeking a career in the biotechnology industry. Students in the program take core classes in both biotech science-related and bio-entrepreneurship curricula. This program combines molecular biology rigor with soft skills to provide the essential background for interfacing research with successful workplace interactions in the biotech industry. Our mission is to provide motivated students with the knowledge and skills needed to successfully enter or advance their careers in the biotechnology industry.

### Admission Requirements and Application to the 4+1 Accelerated Program:

Students must meet the following criteria to be considered for the 4+1 accelerated PSM:

1. Students must apply after their sophomore year in the BS program (Most students apply in the spring semester of their sophomore year.)
2. Maintain a GPA of 3.2 or above in their BS work (both overall and in their major)
3. Submit an essay up to 500 words that describes their interest in the program and future career plans
4. Complete 90 credits by the end of their sixth semester or 60 credits by the end of the fourth semester in the BS
5. Submit an official copy of their transcripts
6. Submit one (1) letter of recommendation from a professor in their major
7. Please note: The GRE is waived for 4+1 applicants.

Applications may be obtained from the Biological Sciences Department.

### ADVANTAGES OF THE 4+1 PROGRAM:

- Once accepted into the PSM program, students can transfer up to 14 credits from their undergraduate courses to the MS degree, provided:
  - They have more than the required 120 credits for their undergraduate degree
  - Students obtain a grade of B or better in each course.
- Students can take up to two graduate-level (400 level or above) science courses during each of their final three semesters.
- Students are charged the undergraduate tuition rate for graduate courses taken during the final three semesters of their undergraduate program.

## Program Learning Outcomes

VU Biology graduates should be able to:

1. **Demonstrate** proficiency in *general biology concepts and theories*, as well as in self-selected biology sub-disciplines in order to succeed in careers and graduate programs.
2. **Illustrate** sufficient proficiency in *calculus, general chemistry, organic chemistry, and physics* in order to understand biological concepts involving these disciplines.
3. **Operate** basic *scientific instruments* necessary for biological investigations such as microscopes, centrifuges, spectrophotometers, electrophoresis equipment and pH meters thus demonstrating competency in *basic laboratory skills*, cell culture, and field techniques.
4. **Design** and conduct experiments –both individually and in small groups– using appropriate strategies such as: *collect, organize, analyze, interpret, and present quantitative & qualitative data and incorporate* them into the broader context of biological knowledge.
5. **Analyze and evaluate** various types of *scientific information* including primary research articles, mass media sources and world-wide web information.
6. **Disseminate** and *present biological data* with theoretical and historical perspectives –both in oral and written formats– to a diverse audience.
7. **Use critical and creative thinking to solve problems** by compiling and analyzing scientific information from library, electronic, and experimental sources. Effectively apply current technology and scientific methodologies for problem solving.
8. **Articulate** historical, current, and theoretical issues relating to biology and society within a Christ-centered worldview that allows for *evaluation of the relationship of scientific theories with ethical and religious perspectives*, particularly those common to Pentecostal Christians.

## Requirements

### Course Requirements:

#### Bachelor of Science in Biotechnology (122 units, 4 years)

Code	Title	Units
Core Curriculum Requirements ( <a href="https://catalog.vanguard.edu/interdisciplinary-offerings/core-curriculum/">https://catalog.vanguard.edu/interdisciplinary-offerings/core-curriculum/</a> )		46
Biotechnology Major Requirements		76
General Electives		0
<b>Total Units</b>		<b>122</b>

#### Biotechnology Major requirements:

Code	Title	Units
<b>Lower Division:</b>		
BIOL-111 & 111L	Principles of Cell and Molecular Biology and Principles of Biology Lab, Principles of Cell/ Molecular Biology Lab	4
BIOL-112 & 112L	Principles of Organismal Biology and Principles of Organismal Biology Lab	4
BIOL-220 & 220L	Cell Biology and Cell Biology Lab	4
BIOT-200 & 200L	Introduction to Biotechnology and Introduction to Biotechnology Laboratory	4



CHEM-120 & 120L	General Chemistry I and General Chemistry I Lab	4
CHEM-121 & 121L	General Chemistry II and General Chemistry II Lab	4
MATH-180C	Calculus I	4
MATH-265C	Intro to Statistical Methods	3
or MATH-270C	Health Professions Statistical Methods	
PSCI-130C & 130CL	General Physics I and General Physics I Lab	4
PSCI-131 & 131L	General Physics II and General Physics II Lab	4
<b>Upper Division:</b>		
BIOL-309 & 309L	Microbiology and Microbiology Laboratory	4
BIOL-440 & 440L	Molecular Biology and Techniques in Molecular Biology	4
BIOL-450 or BIOL-485	UG Research or Internship Program Undergrad Biological Research	2
BIOL-499C	Capstone Seminar in Biology	2
BIOT-403	Adv. Research Methods in Biotechnology	3
BIOT-405 & 405L	Bioinformatics and Bioinformatics Laboratory	4
BIOT-413	Cell Culture Techniques	3
CHEM-304 & 304L	Organic Chemistry I and Organic Chemistry Techniques I	4
CHEM-305 & 305L	Organic Chemistry II and Organic Chemistry Technqs II	4
MNGT-325	Management Theory/Practice	3
CHEM-430 & 430L	Biochemistry and Experimental Tech/Biochemistry	4
<b>Total Units</b>		<b>76</b>

## Master of Science in Biotechnology (22 units, 1 year)

Code	Title	Units
Advanced Project Options (6 units, may be split between two semesters):		6
BIOT-550 or BIOT-685	Internship Program Independent Advanced Research	
BIOT-508	Legal and Social Ethics in Science	3
BIOT-511	Regulations and Quality Management	2
BIOT-515	Experimental Design and Statistical Analysis	3
BIOT-600	Bioinnovation/Entrepreneurship/Biotech	2
BIOT-603	Bus Analytics and Professional Comm	3
BIOT-699	Graduate Seminar	1
PSOG-507	Intro to Psychology and Behavior in Org In Organizations	3
<b>Total Units</b>		<b>23</b>

## Five Year Plan

**Disclaimer:** This sample Four Year Plan is provided as a guide for the recommended sequencing of courses. Vanguard University requires that students complete a minimum of 120 units of required course work as

outlined on the Requirements tab in order to receive a Bachelor of Arts, Bachelor of Music, Bachelor of Science, or Bachelor of Science in Nursing degree. It is the student's responsibility to confirm with the department the course rotation before enrolling in courses. If applicable, please note the footnotes at the bottom of the page for additional information related to courses listed in a particular year and term. Questions, contact the Department of Biology.

**Study Abroad Participation:** Students interested in participating in the university's Study Abroad programs are encouraged to reach out to the Global Education and Outreach Office (studyabroad@vanguard.edu) for more information and collaboration in their academic course planning. Students using Education and Training Benefits through the U.S. Department of Veteran Affairs are encouraged to also reach out to the School Certifying Official (veteranscertifyingofficial@vanguard.edu) for more information regarding how benefits can be applied.

Course	Title	Units
<b>Year 1 Term 1</b>		
CORE-100C	Cornerstone	1
BIOL-111	Principles of Cell and Molecular Biology	3
BIOL-111L	Principles of Biology Lab, Principles of Cell/ Molecular Biology Lab	1
CHEM-120	General Chemistry I	3
CHEM-120L	General Chemistry I Lab	1
NT-101C	New Testament Survey	3
ENGL-120C	Persuasive Writing	3
<b>Units</b>		<b>15</b>
<b>Year 1 Term 2</b>		
BIOL-112	Principles of Organismal Biology	3
BIOL-112L	Principles of Organismal Biology Lab	1
CHEM-121	General Chemistry II	3
CHEM-121L	General Chemistry II Lab	1
PSYC-103C	Introduction to Psychology	3
<b>Units</b>		<b>11</b>
<b>Year 2 Term 1</b>		
BIOL-220	Cell Biology	3
BIOL-220L	Cell Biology Lab	1
CHEM-304	Organic Chemistry I	3
CHEM-304L	Organic Chemistry Techniques I	1
KINE-148C	Lifetime Fitness and Wellness Lecture	3
THEO-101C	Foundations of Christian Life	3
ENGL-220C	Researched Writing	3
<b>Units</b>		<b>17</b>
<b>Year 2 Term 2</b>		
BIOT-200	Introduction to Biotechnology	3
BIOT-200L	Introduction to Biotechnology Laboratory	1
CHEM-305	Organic Chemistry II	3
CHEM-305L	Organic Chemistry Technqs II	1
MATH-PLSTAT	Math Sci Stat Or Into to Stat	3
OT-201C	Old Testament Survey	3



FINA-PLCR	Fine Arts Core Curriculum Requirement	3	BIOT-699	Graduate Seminar	1
	<b>Units</b>	<b>17</b>		<b>Units</b>	<b>8</b>
<b>Year 3 Term 1</b>			<b>Total Units</b>		
MATH-180C	Calculus 1	4			<b>145</b>
PSCI-130C	General Physics I	3			
PSCI-130CL	General Physics I Lab	1			
BIOL-309	Microbiology	3			
BIOL-309L	Microbiology Laboratory	1			
COMM-201C	Speech Composition and Presentation	3			
	<b>Units</b>	<b>15</b>			
<b>Year 3 Term 2</b>					
PSCI-131	General Physics II	3			
PSCI-131L	General Physics II Lab	1			
MNGT-325	Management Theory/Practice	3			
BIOT-413	Cell Culture Techniques	3			
HIST-PLCR1	History Core Req (US Hist Or Democracy)	3			
BIOL-PLUGR	Undergraduate Research or Internship	2			
	<b>Units</b>	<b>15</b>			
<b>Year 4 Term 1</b>					
BIOL-440	Molecular Biology	3			
BIOL-440L	Techniques in Molecular Biology	1			
CHEM-430	Biochemistry	3			
CHEM-430L	Experimental Tech/Biochemistry	1			
THEO-300C	Developing a Christian World View	3			
HIST-PLCR2	History Core Requirement (World Civ)	3			
SOC-PLCR	Social Science Core Curriculum Req'm't	3			
	<b>Units</b>	<b>17</b>			
<b>Year 4 Term 2</b>					
BIOT-403	Adv. Research Methods in Biotechnology	3			
BIOT-405	Bioinformatics	3			
BIOT-405L	Bioinformatics Laboratory	1			
BIOL-499C	Capstone Seminar in Biology	2			
CHIS-400C	Christian Heritage	3			
ENGL-230C	Literature and the Human Experience	3			
	<b>Units</b>	<b>15</b>			
<b>Year 4 Term 3</b>					
BIOT-PLHDRS	Biotechnology Advanced Project Option	6			
	<b>Units</b>	<b>6</b>			
<b>Year 5 Term 1</b>					
PSOG-505	Intro to Psychology and Behavior in Org In Organizations	3			
BIOT-515	Experimental Design and Statistical Analysis	3			
BIOT-508	Legal and Social Ethics in Science	3			
	<b>Units</b>	<b>9</b>			
<b>Year 5 Term 2</b>					
BIOT-603	Bus Analytics and Professional Comm	3			
BIOT-511	Regulations and Quality Management	2			
BIOT-600	Bioinnovation/Entrepreneurship/Biotech	2			