2023-2024 ASSESSMENT REPORT
PROFESSIONAL SCIENCE MASTER'S IN BIOTECHNOLOGY
GRADUATE PROGRAM

Program: **Master's in Biotechnology, PSM**
Degree type: **Graduate program**, College of Arts and Sciences
Assessment coordinator: Brian Young, Program Director, byoung3@usfca.edu

Mission Statement

Mission Statement (no changes made since October 2018):

Our Mission is to provide motivated students with the knowledge and skills needed to successfully enter a career in the biotechnology industry.

Program Learning Outcomes

PSM in Biotechnology Program Learning Outcomes (no changes made since May 2019):

1. Review and evaluate concepts from multiple disciplines (biology, bioinformatics, business) within biotechnology.
2. Interpret and execute best practices in biotech-related lab techniques as well as exhibit an ability to assess the novelty of research and prioritize protocols.
3. Comprehend the need for ethics in science and technology based business/research/industry.
4. Critically review scientific papers and demonstrate science communication skills necessary to attain professional level employment in science and technology based research/industry.
5. Demonstrate effective teamwork, team leadership, business communication skills, and networking skills, including exposure to industry members in molecular biology and biotechnology based business/research/industry.

Curricular Maps

The Curricular map aligning the Institutional Learning Outcomes (ILOs) with the Biotechnology Program Learning Outcomes (PLOs) is included in Appendix A.

The Curricular map aligning required Biotechnology program courses with Biotechnology PLOs is included in Appendix B. No changes have been made to the Curricular map since 2019.

Assessment schedule between APRs

2016-2017: Assessment of **PLO1**
2017-2018: Assessment of **PLO4**
2018-2019: Assessment of **PLO2**
2019: Rewriting and numbering of the PLOs took place.

2019-2020: Alternative assessment reflection on distance learning pivot (no specific PLO assessed)

2020-2021: Assessment of **PLO1**: *Review and evaluate concepts from multiple disciplines (biology, bioinformatics, business) within biotechnology.*

October 2021: Academic Program Review of our PSM in Biotechnology program took place

2021-2022: Assessment of **PLO3**: *Comprehend the need for ethics in science and technology based business/research/industry.*

2022-2023: Assessment of **PLO5:** *Demonstrate effective teamwork, team leadership, business communication skills, and networking skills, including exposure to industry members in molecular biology and biotechnology based business/research/industry.*

Methods: Program Learning Outcome 4

This year, we chose to assess PLO4:

> **PLO4: Critically review scientific papers and demonstrate science communication skills necessary to attain professional level employment in science and technology based research/industry.**

We chose to assess PLO4 in part because it has been the longest period of time (since 2017-2018) since a version of this PLO has been assessed.

To obtain a diverse sample of student work, we evaluated assignments from two courses: BTEC685-Molecular Genetics and Biotechnology and BTEC 688-Advanced Projects. The former is our foundational lab course, the latter builds on student's ability to do research. In BTEC 685 we obtained laboratory Group Meeting presentation videos describing and analyzing student's research. 16 samples were rated. In BTEC 688 we obtained midterm examinations that involved reading and dissecting a recent paper in biotech and evaluated representative questions. 13 samples were rated. Both assignments were evaluated across two criteria in each case using the following rubric (see below). Ratings were assigned by the current biotech assessment coordinator (Dr. Brian Young).

Students will be able to

PLO4: Critically review scientific papers and demonstrate science communication skills necessary to attain professional level employment in science and technology based research/industry.

RUBRIC CRITERIA	**PERFORMANCE STANDARDS**			
	Exceeds Expectations (4)	*Meets Expectations (3)*	*Needs Improvement (2)*	*Below Expectations (1)*
1. Demonstrates analytic ability and depth of understanding in techniques relevant to scientific (biotech) literature	Evidence provided of deep understand of biotechnological experimentation. Abillity to analyze experiments and hypothesize outcomes.	Understand most experiments but may have occasional lapses. Alternatively, may have understanding but has trouble analyzing outcomes.	Demonstrates lack of understanding of several key experiments or inability to analyze results.	No or very little understanding of important methodology and lack of ability to analyze experiments or outcomes.
2. Demonstrates skill in concisely and clearly communicating science relevant to biotech industry.	Clearly explains complex concepts lucidly and concisely.	Able to convey important concepts clearly, though may have trouble with some especially difficult concepts. Occasional extraneous detail.	Communication is sometime cryptic or may be disorganized and includes extraneous detail. Incorrect information.	Rambling and/or incoherent in communicating science. Clearly misunderstanding of science.

Full results are shown in Appendix D. Criteria were averaged across student work and courses and summarized in Table I below.

Table I

Criteria	Average rating	% of rating above 3
Demonstrates analytic ability and depth of understanding in techniques relevant to scientific (biotech) literature	3.4 +/- 0.1	89%
Demonstrates skill in concisely and clearly communicating science relevant to biotech industry.	3.1 +/- 0.1	86%

Results: Program Learning Outcome 4

In general, it seems that students performed well in PLO4, with the averages at or above expectations (3) and a strong majority of students performing at or above expectations.

The last time we assessed PLO4 in 2017-2018, the evaluation scores were similar to this year -- ~ 85% of students were measured as good or excellent. However, a direct comparison between our current PLO4 evaluation and the PLO4 evaluation cannot necessarily be made because in 2019 we modified several of our PLOs, including PLO4. The older version of PLO4 covered business communication as well and read instead as:

PLO4 (2017-18): Critically review scientific papers and demonstrate communication skills appropriate for professional level employment in science and technology-based business/research/industry.

Program response and future improvement

Our program interpreted these results as indicative evidence that the program is helping prepare students with the breadth of experimental understanding, critical thinking skills and communication skills to thrive in the biotech industry. However, we continue to seek ways for students to build the ability to read and think rigorously about science.

Feedback from previous year's assessment report

In the previous years' feedback, we were reminded to be careful about including a non-representative number of significant digits in our reporting. In this report we worked to provide data with more representative precision.

Appendix A: Institutional Learning Outcomes vs. Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5
Institutional Learning Outcomes X Program Learning Outcomes	1. Review and evaluate concepts from multiple disciplines (biology, bioinformatics, business) within biotechnology.	2. Interpret and execute best practices in biotech-related lab techniques as well as exhibit an ability to assess the novelty of research and prioritize protocols.	3. Comprehend the need for ethics in science and technology based business/research/industry.	4. Critically review scientific papers and demonstrate science communication skills necessary to attain professional level employment in science and technology based research/industry.	5. Demonstrate effective teamwork, team leadership, business communication skills, and networking skills, including exposure to industry members in molecular biology and biotechnology based business/research/industry.
Institutional Learning Outcomes					
1. Students reflect on and analyze their attitudes, beliefs, values, and assumptions about diverse communities and cultures and contribute to the common good.			x		
2. Students explain and apply disciplinary concepts, practices, and ethics of their chosen academic discipline in diverse communities.	x		x	x	
3. Students construct, interpret, analyze, and evaluate information and ideas derived from a multitude of sources.	x			x	x
4. Students communicate effectively in written and oral forms to interact within their personal and professional communities.				x	x
5. Students use technology to access and communicate information in their personal and professional lives.		x			
6. Students use multiple methods of inquiry and research processes to answer questions and solve problems.	x	x			
7. Students describe, analyze, and evaluate global interconnectedness in social, economic, environmental and political systems that shape diverse groups within the San Francisco Bay Area and the world.			x		x

Appendix B: Curricular Map – Courses vs. Program Learning Outcomes:

		PLO1	PLO2	PLO3	PLO4	PLO5
	Biotechnology course Curricular Map 2020-2021	1.Review and evaluate concepts from multiple disciplines (biology, bioinformatics, business) within biotechnology.	2.Interpret and execute best practices in biotech-related lab techniques as well as exhibit an ability to assess the novelty of research and prioritize protocols.	3.Comprehend the need for ethics in science and technology based business/research/industry.	4.Critically review scientific papers and demonstrate science communication skills necessary to attain professional level employment in science and technology based research/industry.	5.Demonstrate effective teamwork, team leadership, business communication skills, and networking skills, including exposure to industry members in molecular biology and biotechnology based business/research/industry.
Semester	**Courses or Program Requirement**					
1	**BTEC601**: Career Preparation Seminar - seminar, 1 unit				I	I
1	**BTEC610**: Global and U.S. Regulatory Affairs - lecture, 2 units			D	D	D
1	**BTEC611**: Legal-Social-Ethical Biotech - lecture, 2 units			M	D	D
1	**BTEC620**: Molecular Biology - lecture, 4 units	I		I	I	
2	**BTEC612**: Local, National, Global Biotech - lecture, 2 units				D	I
2	**BTEC615**: Bioinnovation Management - lecture, 2 units				D	M
2	**BTEC619**: Bioentrepreneurship AGI - fieldwork, 2 units				D	M
2	**BTEC685/686**: Molecular Genetics and Biotechnology - lab, 4 units	D	I		D	
3	**BTEC688/689**: Advanced Research Methods - lab, 4 units		M		D	
3	**BTEC640**: Bioinformatics - lecture, 4 units	D	D			
4	**BTEC600**: Molecular Biology seminar - seminar, 1 unit				D	D
4	**BTEC697**: Internship in Biotechnology - fieldwork, 4 units		M		M	M
4	**BTEC elective**: lecture, 4 units	M			D	
		Key:				
		I = Introductory				
		D = Developing				
		M = Mastery				

Appendix C: Raw data

BTEC 688-01 Midterm Exam questions #5 and question #8

Student	Criteria #1	Criteria #2
1	3	2
2	3	3
3	4	4
4	4	3
5	4	3
6	4	4
7	4	3
8	4	3
9	3	3
10	3	2
11	4	3

12	4	3
13	2	2
Average	3.53846154	2.92307692

BTEC 685-02 Group Meeting Presentations

1	4	4
2	3	3
3	4	4
4	3	4
5	4	4
6	4	4
7	4	3
8	4	3
9	3	4
10	1	1
11	2	3
12	4	3
13	3	3
14	3	3
15	3	4
16	3	3
Average	3.25	3.3125