

**2021-2022 ASSESSMENT REPORT  
PROFESSIONAL SCIENCE MASTER'S IN BIOTECHNOLOGY  
GRADUATE PROGRAM**

Program: **PSM in Biotechnology**

Degree type: **Graduate program**, College of Arts and Sciences

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**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 C.

The Curricular map aligning required Biotechnology program courses with Biotechnology PLOs is included in Appendix D. No changes have been made to the Curricular map since 2019. Based on this assessment report process, we will be working on an updated Curricular map over the course of the spring 2023 semester. We have attached a proposed new version of our Curricular map in Appendix E.

### Assessment schedule between APRs

**2015-2016:** Assessment of **PLO5:** *Perform key molecular biology laboratory techniques (such as PCR, gel electrophoresis, DNA isolation, RT-PCR, CRISPR).*

This is a PLO that was modified significantly when we did our PLO revisions in 2019. No direct assessment or rating of the work products from students was being done at this time.

**2016-2017:** Assessment of **PLO1:** *Interpret concepts from multiple disciplines (biology, bioinformatics, business) within biotechnology.*

This PLO was modified when we did our PLO revisions in 2019. No direct assessment or rating of the work product from students was being done at this time.

**2017-2018:** Assessment of **PLO4:** *Critically review scientific papers and demonstrate communication skills appropriate for professional level employment in science and technology based business/research/industry.*

We began doing direct assessment and rating of student work products this year. This is a PLO that was modified significantly when we did our PLO revisions in 2019. The old PLO4 was split into our current PLO4 and PLO5. We did the PLO revisions that year partially based upon our findings during the assessment process.

**2018-2019:** Assessment of **PLO2:** *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.*

**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.*

### Methods: Program Learning Outcome 3

This year, we chose to assess PLO3:

**PLO3: *Comprehend the need for ethics in science and technology based business/research/industry.***

As described in our annual assessment report from last year, we chose to assess PLO3 because we have never performed direct assessment of this PLO. Last year we incorporated ethics-based written assignments into our curriculum so that we could effectively assess this PLO.

Developing a deep understanding and mastery of knowledge of ethics in the field of biotechnology is, what we believe, an essential aspect of our program. Not only is this an important part of educating our students as they go on to become working professionals in the biotechnology sector, it is also an important part of the mission of the University and aligns with the foundation of a Jesuit education.

As described in our curricular map, to assess PLO3, students should be gaining, developing, and then demonstrating mastery in two of the five courses that are part of the bioentrepreneurship block of the PSM in Biotech program. These include BTEC 610, BTEC 611, BTEC 612, BTEC 615 and BTEC 619. Additionally, students are introduced to the topic of ethics in the biotechnology field in BTEC 620, however not all students are required to take this course. If they have completed Molecular Biology previously (either undergraduate or graduate), students are allowed to substitute another course.

However, after discussing the various materials that were submitted over the 2021-2022, we chose to review materials submitted in Prof. Cary Lai's BTEC 685/686 (Molecular Biology and Biotechnology lecture/lab) course. Students in the BTEC 685 were given a choice to write a report focusing on ethics or a report focused on the business side of a CRISPR target. Unfortunately, relatively few (4 in total) selected the ethics assignment, so there is a fairly small pool to review.

### **Results: Program Learning Outcome 3**

Student assignments from the BTEC 685 course were rated using the same PLO3 assessment rubric on a 1-10 point scale, with scores of 4 or lower being weak, scores of 5-6 being satisfactory, scores of 7-8 being good, and scores of 9-10 being excellent (see Appendix A).

The complete results are shown in Appendix B. The BTEC 685 (Cary Lai's section) had a mean score of 7 (out of 10) with a standard deviation of 0.71. Based on the rubric, of the students assessed for this ethics assignment, the majority obtained a score of "good", meaning they had a strong understanding of bioethical situations. To fully assess the success of our accomplishment of PLO #3, a more comprehensive set of materials is necessary. We have begun discussing what courses should include an ethics component to assess in the future.

### **Program response and future improvement**

Clearly this particular assignment was not ideal for the ethics assessment, and is something that we could improve on in the future. For example, we have discussed requiring all of the students to have at least some ethics analysis in their reports in the BTEC 685/686 course, since this is a required course all students take in their first year and would provide a more accurate reflection of our accomplishment of PLO #3.

Additionally, we have discussed including an ethics discussion in the BTEC 600 Seminar course. This would be modeled after the NIH requirement to include an ethics component in coursework required by students receiving an NIH stipend during their graduate education. This would ensure there is both a learning component as well as assessment component to this PLO.

Furthermore, we will be discussing this particular PLO and how our assessment relates to the courses in the PSM in Biotechnology program. We feel it is important to specifically review BTEC 610: Global and U.S. Regulatory Affairs, BTEC 611: Legal-Social-Ethical Biotech and BTEC 620: Molecular Biology and their mapping to PLO #3. In our current version of the curriculum map, these three courses cover PLO in varying levels, where students are introduced to concepts covering this PLO in BTEC 620, are developing skills in BTEC 610 and should have mastered the skills in BTEC 611. Specifically, we chose these three assignments to assess:

- BTEC 610 - Global and U.S. Regulatory Affairs
- BTEC 611 - Legal-Social-Ethical Biotech
- BTEC 620 – Molecular Biology

For all three of these classes, we would like to gather assignments from each student were collected and then evaluated for how well they achieve PLO3.

### **Feedback from previous year's assessment report**

For the 2020-2021 year, we assessed PLO 1. Our faculty used a common rubric to assess the quality of the reports submitted by the students following seminars delivered by professionals in different areas within the biotech sector. One comment provided on the assessment report was “while all results were presented, it is not clear if multiple faculty reviewed each report or simply the course instructor. The former is the desired process as it eliminates bias within a course. It also serves to educate program faculty on student achievement through the program outside of their individual courses.”

We have kept this in mind as we reviewed material in order to assess PLO 3 this year. In addition to the course instructor, we had another faculty member review the submitted materials for assessment. This was a very productive approach as it help spur deeper conversations about our current curricular map and assessment approaches. We will be discussing the assessment process over the spring semester in preparation for the 2022-2023 assessment report.

## Appendix A: Biotechnology PSM PLO3 assessment rubric:

### Ethics Assessment Rubric

#### Fulfilling Ethics PSM PLO3

**PLO3:** Comprehend the need for ethics in science and technology based business/research/industry.

Criteria	Ratings			
	Weak (1-4)	Satisfactory (5-6)	Good (7-8)	Excellent (9-10)
<b>PLO3:</b> Comprehend the need for ethics in science and technology based business/research/industry .	Student does not demonstrate competent understanding of any of the bioethical situations and how to apply ethical frameworks to these situations, in both of the two BioE (debate and paper) assignments.	Student demonstrates a strong understanding of the bioethical situations and how to apply ethical frameworks to these situations, in only one of the two BioE (debate and paper) assignments.	Student demonstrates a strong understanding of bioethical situations and how to apply ethical frameworks to these situations, in both of the two BioE (debate and paper) assignments	Student demonstrates a thorough understanding of bioethical situations and how to apply ethical frameworks to these situations, in both of the two BioE (debate and paper) assignments

**Total Points:** \_\_\_\_\_ out of 10

**Rater notes:**

**Appendix B: Assessment raw data:**

<b>BTEC 685 Ethics Papers</b>			
<b>Weak (1-4)</b>	<b>Satisfactory (5-6)</b>	<b>Good (7-8)</b>	<b>Excellent (9-10)</b>
<b>Student</b>	<b>BY score</b>		<b>Topic</b>
Andrew Chan	8		Ethics
Anjali Dhawana	7		Ethics
Lindsey Facen	7		Ethics
Hannah Hirou	6		Ethics
<b>Business Papers</b>			
Yasmin Arjomandi			
Yi Chen Chih			
Irene Faizi			
Kimberly Kwan			
Nicole McHugh			
Vanessa Nguyen			
Ricard Rubio			
Shruti Shah			
Alicia Stevens			
Tiffany Thaphasouk			

## Appendix C: 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.
<b>Institutional Learning Outcomes</b>					
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 E: Curricular Map – Courses vs. Program Learning Outcomes (proposed revisions):**

Biotechnology course Curricular Map (with proposed revisions)		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	<b>BTEC601:</b> Career Preparation Seminar - seminar, 1 unit				I	I
1	<b>BTEC610:</b> Global and U.S. Regulatory Affairs - lecture, 2 units			D	D	D
1	<b>BTEC611:</b> Legal-Social-Ethical Biotech - lecture, 2 units			M	D	D
1	<b>BTEC620:</b> Molecular Biology - lecture, 4 units			I	I	
2	<b>BTEC612:</b> Local, National, Global Biotech - lecture, 2 units				D	I
2	<b>BTEC615:</b> Bioinnovation Management - lecture, 2 units				D	M
2	<b>BTEC619:</b> Bioentrepreneurship AGI - fieldwork, 2 units	M			D	M
2	<b>BTEC685/686:</b> Molecular Genetics and Biotechnology - lab, 4 units		I		D	
3	<b>BTEC688/689:</b> Advanced Research Methods - lab, 4 units		M		D	
3	<b>BTEC640:</b> Bioinformatics - lecture, 4 units		D			
4	<b>BTEC600:</b> Molecular Biology seminar - seminar, 1 unit	D			D	D
4	<b>BTEC697:</b> Internship in Biotechnology - fieldwork, 4 units	M	M		M	M
4	<b>BTEC elective:</b> lecture, 4 units				D	
		<b>Key:</b>				
		<b>I = Introductory</b>				
		<b>D = Developing</b>				
		<b>M = Mastery</b>				