Enter College: College of Science and Mathematics

Enter Department/Program: Physics/ BS in Biomedical Physics

Student Outcomes Assessment Plan (SOAP)

I. Mission Statement

The mission of the Undergraduate Biomedical Physics Program at Fresno State is to provide students with a rigorous undergraduate-level introduction to the field of Medical Physics, including radiation physics, health physics, anatomy, physiology, medical imaging, and, at their option, radiation therapy. To accomplish this, the program offers courses to provide students with preparation for graduate instruction in Medical Physics and other areas of quantitative medicine (computational neuroscience, molecular imaging, etc.), as well as for other careers for which a broad-based, interdisciplinary scientific background is an asset.

II. Goals and Student Learning Outcomes

Program Goals:

The Biomedical Physics program's expectations for student learning are based on core ***graduate*** curriculum in the Standards for Accreditation of Graduate Educational Programs in Medical Physics (Revised July 2015) by the Commission on Accreditation of Medical Physics Educational Programs, Inc. (CAMPEP). This is to ensure that students graduating from this program are well prepared for graduate instruction in medical physics (M.S. or Ph.D.) or related fields. There is no accrediting body for ***undergraduate*** medical physics programs in the US. Fresno State is a pioneer in establishing the first undergraduate biomedical physics program in the nation.

Goal 1: Knowledge of Physics

Biomedical Physics students will develop competence in essential core disciplines identified as fundamental in physics such as classical mechanics, electricity and magnetism (E&M), thermodynamics, and quantum mechanics (QM).

Student Learning Outcomes: Graduates will be able to:

1.1 Identify, analyze, and solve problems within the core disciplines mentioned above at the level defined by the textbook *Physics for Scientists and Engineers by Serway and Jewett.*

1.2 Conduct laboratory work in physics in a safe and socially responsible manner, keeping accurate and complete records of their work, properly using standard laboratory equipment and instruments.

1.3 Students will evaluate the reliability and significance of laboratory data.

Goal 2: Knowledge and Understanding of Biomedical Physics

The students will appreciate and understand the physical and mathematical principles underlying medical imaging and health physics and demonstrate the application of these concepts and theories.

Student Learning Outcomes: Graduates will be able to:

2.1 Describe fundamental concepts, discuss underlying principles, and solve basic problems in biomedical physics as identified in textbooks used as standards in *graduate education* such as
Introduction to Health Physics by Cember
Fundamentals of MRI by Berry and Bulpitt
The Essential Physics of Medical Imaging by Bushberg, Sieberg, Leidholdt, and Boone
Physics in Nuclear Medicine by Cherry, Sorenson, and Phelps.

2.2 Collect data and analyze results on medical imaging equipment as part of "hands-on" experience at the local medical centers.

2.3 Communicate their understanding and results from the "hands-on" laboratory experience in common written format.

2.4 Students will apply basic knowledge in applied statistics, error analysis, and experimental design and methods in radiation instrumentation.

III. Curriculum Map (Matrix of Courses X Learning Outcomes)

BS Biomedical Physics Program Curriculum Map

This table provides information regarding how the outlined student learning outcomes are introduced (I), emphasized (E), reinforced (R) and mastered (M) as students advance through the curriculum.

	SLO1.1	SLO1.2	SLO1.3	SLO2.1	SLO2.2	SLO2.3	SLO2.4
Phys 4A, 4AL	I	I	I			I	I
Phys 4B,4BL	I	E	E			E	E
Phys 4C	E						
Phys 102	R			I			
Biol 67A							
Biol 144							
Phys 135		R	R	I	I	R	R
Phys 136				E			
Phys 137				R			M
Phys 155				I			
Phys 156		M		M	E		
Phys 157		M		M	R		
Phys 158				M	M		
Phys 190 (Elective)				M	M	M	M

IV. Assessment Methods

A. Direct Measures: (A minimum of three are required.)

1. **Embedded Questions in Final Exam in Phys 4AB**: Outcome 1.1 to 1.3 will be assessed via validated embedded questions in final exams. For each specific course (e.g. Phys 4A), final exams will contain three standardized embedded questions which will be shared across sections and from semester to semester. These questions will be identical in all but numerical values and will represent three areas of course specific essential knowledge including the labs as defined by committees of the prospective instructors of these courses.

   Benchmark: It is expected that students passing the course will score above 50% correct responses on the embedded questions. The results will be used to identify weaknesses in the curriculum of the courses.

2. **Student Grades in Phys 135, 136, 137, 156, 157:** Biomedical Physics is a small program by its very nature and allows for one-to-one interaction with the student and the professor. As such, a grade based on written assignments, problem-solving, midterm(s) and a comprehensive final exam can serve as a good measure to assess learning outcomes. Phys 136 grade will be used to assess the initial understanding of students of basic math and physics of radiation. Grades in Physics 135, 137, 156, and 157 will be used to assess student understanding of: the physical principles underlying each imaging modality, the physical properties that are visualized in each type image, the general types of medical and biological information that these properties can reveal, and the limitations of each imaging modality in acquiring clinical information thus, satisfying learning outcomes 2.1, 2.2, and 2.4.

   Benchmark: It is expected that for the first courses in the sequence (Phys 135, 136), 50% of the students will score a grade of C or better in these courses. However, as the students go on to upper-level courses, we expect 67% of the students to score a grade of C or better in these courses. The grades will be used to identify weaknesses in the curriculum of these courses.

3. **Artifacts of student lab reports in Phys 135:** Phys 135 is a “hands-on” clinical lab experience that requires students to design, conduct, and communicate the nature of experiments via elaborate lab reports in a format and manner appropriate to publishing in a journal. Artifacts of student performance (lab reports, lab activities, participant observation) will be used to assess outcome 2.3.

   Benchmark: It is expected that 67% of the students will score a grade of C or better in the lab portion of the course. Any deviation will be used to identify weaknesses in the format and delivery of the course.

B. Indirect Measure(s): (Departments are required to have one indirect measure. Examples of indirect measures are senior exit surveys, a focus group, written reflections by students, and of course alumni surveys which departments may choose to conduct.)

1. **Existing Student and Faculty Feedback:** At least once every five years, the department will hold a focus group with existing biomedical physics majors. This will provide an opportunity to identify emerging problems quickly before they show up in tracked data. In addition, the department will periodically collect feedback from permanent and temporary faculty and instructors on their perceptions of both curriculum and student strengths and weaknesses.

V. Student Learning Outcomes X Assessment Methods Matrix

	SLO1.1	SLO1.2	SLO1.3	SLO2.1	SLO2.2	SLO2.3	SLO2.4
Embedded Questions in Final Exam in Phys 4AB	X	X	X				
Student Grades in Phys 135, 136, 137, 156, 157				X	X		X
Artifacts of student lab reports in Phys 135						X	
Existing Student and Faculty Feedback	X				X	X	X

VI. Timeline for Implementation of Assessment Methods and Summary Evaluations

Year 2015 to 2016

Method 1: **Embedded Questions in Final Exam in Phys 4AB**

Year 2016 to 2017

Method 1: **Artifacts of student lab reports in Phys 135**

Year 2017 to 2018
Method 1: **Student Grades in Phys 135, 136, 137, 156, 157** Method 2 (if applicable): **Existing Student and Faculty Feedback**

VII. Process for Closing the Loop

The Department of Physics, will convene on an annual basis an Undergraduate Committee. The members of the Undergraduate Committee are responsible for designing and carrying out assessment activities with the help of the entire faculty as needed. The Undergraduate Committee also analyzes the resulting data and suggests changes to the program as necessary. Assessment data and suggested program changes are presented to the entire faculty during a regular faculty meeting, and the entire faculty will decide whether to implement any changes (and they are also free to suggest their own changes).