Department of Biology
College of Science and Engineering (CoSE)

Annual Assessment - PLOs

July 10, 2019

Submitted by Dr. Laura Burrus (Chair)
The Biology Department was very busy in AY2018. In addition to significant revisions of our BS degree and our MS of Biology, we also updated our PLOs for our undergraduate BA and BS degrees as well as our MS in Biology. Our new PLOs are described below.

Revisions to Programmatic Learning Outcomes for our undergraduate BA and BS degrees

The Biology Department has worked to revise the Programmatic Learning Outcomes (PLOs) for Biology majors with two goals in mind: 1) creation of a program that emphasizes a set of core concepts and competencies and 2) creation of a program that we can easily assess and, as a consequence, revise and improve based on quantitative feedback about students’ mastery of fundamental concepts and skills.

With the guidance and support of the Teagle Program, the Department developed a formal set of PLOs based on the *National Science Foundation’s Vision and Change Proposal*. Vision and Change defines a set of five core concepts and six core competencies that Biology undergraduates should master by the time they graduate. By bringing our curriculum into alignment with the goals of NSF’s Vision and Change and systematically assessing student progress, we will be preparing students to meet the challenges they will face in their careers after graduating from SFSU. We will also be able to determine how effectively we are helping students to achieve the goals of the PLOs and can then adjust our teaching and curriculum accordingly.

The eight PLOs we have adopted reflect the increasingly integrative nature of research in Biology and will provide an assessable set of student success outcomes that we can use to guide the reorganization and refinement of our curriculum for years to come. Ultimately, the skills and knowledge students will acquire in a curriculum designed around these PLOs will provide them with a solid foundation to pursue a wide variety of biology-related careers, including careers in basic and applied research, health-related professions and public service.

The core concepts and competencies that will be introduced and practiced throughout the curriculum are as follows:

**Core Competencies**

1. *Understand the process of science*: Students can design an experiment with the appropriate control groups to test an hypothesis
2. *Quantitative reasoning*: Students can interpret a graph or dataset to determine if the results of an experiment support or reject an hypothesis
3. *Relationship between science and society*: Students can weigh the costs and benefits to society of the use of recent scientific and technological developments

**Core Concepts**

1. *Evolution*: Students can explain the role that variation between individuals plays in the processes of natural selection and evolution.
2. *Relationship between structure and function*: Students can explain how a change in the structural characteristics of a molecule, tissue or organism will affect its function
3. *Information flow, exchange and storage*: Students can describe the mechanisms of information flow in classical and molecular genetics and predict the outcomes of crosses
4. *Pathways and transformation of matter and energy*: Students can explain how a carbon molecule flows through a biological process or system
5. Systems (i.e. living systems are interconnected and interacting): Students can predict the consequences of how a change in one aspect of a biological or complex system will affect other aspects of the system

Significant discussion went into designing these PLOs so that they not only represent the core knowledge and skill set required of Biology students but that also are assessable in many different ways and across multiple disciplines in Biology. Understanding the process of science could, for instance, be assessed in the form of a short essay by asking students to design an experiment to test a specific hypothesis, generating and justifying all the necessary groups de novo, or in a multiple-choice format in which they might be asked to identify the appropriate control group for a given manipulation. Assessing the transformation of matter and energy could be assessed in some classes by describing the process of photosynthesis and in others by describing the flow of energy through food webs.

Revisions to Programmatic Learning Outcomes for our MS in Biology

The Biology Department has worked to revise the Programmatic Learning Outcomes (PLOs) for its revised MS in Biology, which was proposed in Spring 2019 (but not yet approved). The new PLOs and the overlay with courses are shown in the table below.

<table>
<thead>
<tr>
<th>Program Learning Objectives</th>
<th>Required</th>
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<th>Required</th>
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<tbody>
<tr>
<td>PLO1: Critically read and evaluate the significance and validity of peer-reviewed publications to develop a comprehensive knowledge of research in their field of expertise and to be able to clearly articulate such knowledge.</td>
<td>Introduced</td>
<td>Developed</td>
<td>Developed</td>
<td>Mastered</td>
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<tr>
<td>PLO2. Conduct original research in a biological sub-discipline, including the design of experiments, development and testing of hypotheses, application of quantitative analyses to visualize and interpret data and derive conclusions.</td>
<td>Introduced</td>
<td>Developed</td>
<td>Developed</td>
<td>Mastered</td>
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<td>PLO3. Develop effective writing skills for both informal and formal professional communications that include a written thesis, scientific proposal, or scientific manuscript.</td>
<td>Introduced</td>
<td>Developed</td>
<td>Developed</td>
<td>Mastered</td>
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<td>PLO4. Develop skills to orally present scientific material to a broad range of audiences, including in courses and an oral thesis defense.</td>
<td>Introduced</td>
<td>Developed</td>
<td>Mastered</td>
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<td>PLO5. Practice the responsible and ethical conduct of research and professional integrity in carrying out scientific investigation</td>
<td>Introduced</td>
<td>Developed</td>
<td>Mastered</td>
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The PLOs were introduced, discussed, and approved by the Department of Biology faculty. They were used to create the curricular revisions and can now be used for further course development in the future.