Learning Outcomes Summary

Program: Physics – Minor

Department: Physics and Astronomy

Number of students enrolled in the program in Fall 2011: 12

Faculty member completing template: William DeGraffenreid (Date: 1/29/2012)

Period of reference in the template: 2006-07 to present

1. Please describe your program’s learning-outcomes trajectory since 2006-07: Has there been a transformation of organizational culture regarding the establishment of learning outcomes and the capacity to assess progress toward their achievement? If so, during which academic year would you say the transformation became noticeable? What lies ahead; what is the next likely step in developing a learning-outcomes organizational culture within the program? [Please limit your response to 200 words or less]

Our current assessment plan was revised in January of 2008, and is based in large part on the 2001 plan. The changes in 2008 were intended to focus the plan on our academic program as a whole, and away from individual courses. It is rather holistic and not very rubric driven. The plan was developed for students in our bachelor degree programs. The desired outcomes for the minor in Physics are identical, but we have not developed a specific set of tools to assess this minor. Minors, not having the requirement or a Senior Project and being relatively small in number, contribute rather insignificantly to our overall plan.

2. Please list in prioritized order (or indicate no prioritization regarding) up to four desired learning outcomes (“takeaways” concerning such elements of curriculum as perspectives, specific content knowledge, skill sets, confidence levels) for students completing the program. For each stated outcome, please provide the reason that it was designated as desired by the faculty associated with the program. [Please limit your response per outcome to 300 words or less]

There are no specific learning outcomes developed for this program. However, all of the learning outcomes from our Department assessment plan are applicable to varying degrees.

a) Physics Knowledge

Students in this program will develop a broad understanding of the basic principles of physics and have a firm foundation for acquiring new knowledge and applying it in a variety of situations. We desire our students to be well schooled in the theories and laws of physics.
b) Analytic Reasoning

In addition to Physics content, students should develop problem solving, critical thinking, and analytical skills and be able to learn new skills as needed. This is an especially important area since quantitative “critical thinking” is badly needed in all technical pursuits and a good Physics background is extremely effective in providing this. It is no accident that people with Physics training are found in every field in which the connection between mathematics and reality is important. Here, it is important to make the students explicitly aware that the development of general analytical skills is at least as high a priority as the course material itself. We have identified three main focus areas in this outcome, namely theoretical, computational, and experimental physics. Not all courses lend themselves to all of these areas, but a student going through our program will have exposure to all of them.

c) Technical Skills

Physics students must be exposed to a broad range of technical skills and should become proficient in most. We strive to expose students to and develop proficiency in using a wide variety of instruments, tools, and software programs.

d) Communication Skills

Scientists must be able to share their ideas and work with others in their field. The demands of such technical writing (and speech) are generally beyond the scope of the writing requirements as defined in the University General Education program. Very complex theories and experiments must be described in unambiguous terms often peppered with large amounts of mathematics and technical jargon. Large data sets, measured or theoretically generated, must be presented clearly and succinctly in tables and graphs. Scientists must also be able to effectively share their results in other forms, such as conference presentations and poster sessions.

3. For undergraduate programs only, in what ways are the set of desired learning outcomes described above aligned with the University’s Baccalaureate Learning Goals? Please be as specific as possible. [Please limit your response to 400 words or less]

Our program has a very strong overlap with the Baccalaureate Learning Goals (BLGs). Our primary learning outcome, Physics Knowledge, aligns with the first two BLGs, Competence in the Discipline and Knowledge of Human Cultures and the Physical/Natural World. Physics minors are exposed to subjects that have been fundamental in the understanding the universe and the development of the modern world. They are exposed to contemporary research that is shaping our future. The third BLG is Intellectual and Practical Skills. By the very nature of studying physics, our students gain mathematical, computer, instrumentation, and problem solving skills
that are not only useful in their professional preparation, but in all aspects of their lives. We emphasize the portability of such skills as they effectively constitute our second learning outcome. Our desire to develop communication skills in graduates also aligns with the third BLG.

The fourth BLG focuses on Personal and Social Responsibility. The process of doing science has significant ethical issues which are addressed in all of our laboratory courses. Students are held to rigorous ethical standards and are taught how to process the data that they collect appropriately. Most laboratory work is also done in groups, as in the “real world,” and students learn how to work with others. The final BLG is Integrative Learning. As physics minors are not compelled to do a Senior Project, there is no capstone project for them to demonstrate integrative learning, but the desire to pursue a minor in physics as a complement to their major indicates a strong desire to integrate multiple fields.

4. For each desired outcome indicated in item 2 above, please: Describe the method(s) by which its ongoing pursuit is monitored and measured. Include a description of the sample of students (e.g., random sample of transfer students declaring the major; graduating seniors) from whom data were/will be collected and the frequency and schedule with which the data in question were/will be collected. Describe and append a sample (or samples) of the “instrument” (e.g., survey or test), “artifact” (e.g., writing sample and evaluative protocol, performance review sheet), or other device used to assess the status of the learning outcomes desired by the program. Explain how the program faculty analyzed and evaluated (will analyze and evaluate) the data to reach conclusions about each desired student learning outcome. [Please limit your response to 200 words or less per learning outcome]

(If the requested data and/or analysis are not yet available for any of the learning outcomes, please explain why and describe the plan by which these will occur. Please limit your response to 500 words or less.)

a) Physics Knowledge

The Physics Knowledge outcome is directly assessed in two ways, 1) analyzing exams and final course scores in upper division physics courses, and 2) analyzing examples of student work such as lab reports, journals, and computational physics projects.

For evaluating individual courses, instructors are asked to provide three exams from each course selected (on a rotating schedule), representing excellent, satisfactory, and poor performance. With names are redacted from the exams, the Committee reviews them to ensure that they properly reflect the required course content, and that the exams were neither too simple nor too difficult for the level of the course. Just as importantly, the Committee examines the student work for significant deficiencies in the core areas of physics, and recommends steps to be taken to remedy such shortcomings. The Committee
also looks at the scores assigned to the students of the three examples to ensure that grading was fair and represented a real evaluation of the abilities of the students.

We do not currently have a specific rubric for evaluating physics knowledge. Our conclusions are based on the committee’s collective assessment of the work submitted. As stated above, we plan to develop a more structured process for evaluating this category.

b) Analytic Reasoning

Analytic Reasoning is directly assessed in two ways, 1) analyzing exams and final course scores in upper division physics courses, and 2) analyzing examples of student work such as lab reports, journals, and computational physics projects.

As noted above, instructors provide name-redacted exams from each course, representing excellent, satisfactory, and poor performance. The sample student exams are studied by the Committee for evidence of mathematical reasoning and critical thinking. Exams are an excellent opportunity for this because the students are required to show their work, giving the Committee insight into their problem solving processes. When laboratory work is provided, the committee can readily assess the experimental and computation skills.

c) Technical Skills

Technical Skills are assessed by reviewing submitted laboratory work. By seeing how the wide variety of instruments and software used in their work is used while performing experiments, the committee is able to analyze how skillful they have become at using these tools.

d) Communication Skills

By reviewing the work submitted by our students we are able to assess the written communication skills of our students. Conclusions are based on the collective discussion of the faculty members on the assessment committee.

5. Regarding each outcome and method discussed in items 2 and 4 above, please provide examples of how findings from the learning outcomes process have been utilized to address decisions to revise or maintain elements of the curriculum (including decisions to alter the program’s desired outcomes). If such decision-making has not yet occurred, please describe the plan by which it will occur. [Please limit your response to 200 words or less per item]
a) Physics Knowledge

We have no specific examples to provide that would apply uniquely to the Physics minor program. There have been adjustments made to our major programs as noted in their reports.

e) Analytic Reasoning

We have no specific examples to provide that would apply uniquely to the Physics minor program. There have been adjustments made to our major programs as noted in their reports.

b) Technical Skills

We have no specific examples to provide that would apply uniquely to the Physics minor program. There have been adjustments made to our major programs as noted in their reports.

c) Communication

We have no specific examples to provide that would apply uniquely to the Physics minor program. There have been adjustments made to our major programs as noted in their reports.

6. Has the program systematically sought data from alumni to measure the longer-term effects of accomplishment of the program’s learning outcomes? If so, please describe the approach to this information-gathering and the ways in which the information will be applied to the program’s curriculum. If such activity has not yet occurred, please describe the plan by which it will occur. [Please limit your response to 300 words or less]

We have not sought the input from our minors. In recent years, there have not been very many, but attempting to contact them may provide some useful information about the long-term effects of having earned the minor.

7. Does the program pursue learning outcomes identified by an accrediting or other professional discipline-related organization as important? Does the set of outcomes pursued by your program exceed those identified as important by your accrediting or other professional discipline-related organization? [Please limit your response to 300 words or less]

There is no accrediting body for physics programs.
8. Finally, what additional information would you like to share with the Senate Committee on Instructional Program Priorities regarding the program's desired learning outcomes and assessment of their accomplishment? [Please limit your response to 200 words or less]

In 2003 a significant overhaul of the physics program was undertaken, including the minor. The number of required upper division physics courses was increased to nine units (which brought it in line with minor programs at similar institutions), thus increasing the exposure to advanced topics in physics.