Template
Academic Program
Plan for Assessment of Student Learning Outcomes
The University of New Mexico

A. College, Department and Date

1. College: Arts and Science
2. Department: Physics and Astronomy
3. Date: Dec 3, 2008

B. Academic Program of Study*

BA Physics and Astrophysics

C. Contact Person(s) for the Assessment Plan

Richard Rand, Associate Professor, Undergraduate Committee Chair, rjr@phys.unm.edu

D. Broad Program Goals & Measurable Student Learning Outcomes

☐ *[Attach Cover Sheet for Student Learning Outcomes and associated materials.]*

OR

[List below:]

1. Broad Program Learning Goals for this Degree/Certificate Program

A. *Physics knowledge.* To provide students with the basic foundation in physics and astronomy, and in the scientific method (especially the interplay of theory and experiment), and to motivate scientific enthusiasm and curiosity and the joy of learning.

B. *Problem solving skills.* To provide students with the tools needed to analyze problems, apply mathematical formalism and experimentation, and synthesize ideas.

C. *Employment and technical skills.* To provide the students with technical skills necessary for successful alternative careers for which a physics foundation can be very useful. These include mathematics, computers, electronics and devices, and communication skills (oral and written).

2. List of Student Learning Outcomes (SLOs) for this Degree/Certificate Program

A.1. Students will a) demonstrate an understanding of concepts of physics, astronomy and optics, b) show understanding of the interplay between theory and experiment, and c) exhibit curiosity and enthusiasm for learning science

* Academic Program of Study is defined as an approved course of study leading to a certificate or degree reflected on a UNM transcript. A graduate-level program of study typically includes a capstone experience (e.g. thesis, dissertation, professional paper or project, comprehensive exam, etc.).

B.1. Students will demonstrate an ability to analyze problems
B.2. Students will demonstrate mathematical ability (in areas such as integration, differential equations, linear algebra and vector calculus) in solving problems
B.3. Students will successfully carry out experiments to arrive at scientific results

C.1. Students will successfully apply computing tools to problems
C.2. Students will communicate well, orally and in writing, in a scientific context
C.3. Students will be able to use laboratory devices and electronics in scientific applications

E. Assessment of Student Learning Three-Year Plan

All programs are expected to measure some outcomes annually and to measure all priority program outcomes at least once over two consecutive three-year review cycles. Describe below the plan for the next three years of assessment of program-level student learning outcomes.

1. Student Learning Outcomes

[Insert at least 2-5 priority learning outcomes that will be assessed by the unit over the next three years. Each unit will select which of its learning outcomes to assess.]

Relationship to UNM Student Learning Goals (insert the program SLOs and check all that apply):

University of New Mexico Student Learning Goals				
Program SLOs	Knowledge	Skills	Responsibility	Program SLO is conceptually different from university goals.
A.1. Students will a) demonstrate an understanding of concepts of physics and astronomy, b) show understanding of the interplay between theory and experiment, and c) exhibit curiosity and enthusiasm for learning science	X	X	X	
B.1. Students will demonstrate an ability to analyze problems	X	X	X	
B.2. Students will demonstrate mathematical ability (in areas such as integration, differential equations, linear algebra and vector calculus) in solving problems	X	X	X	
B.3. Students will successfully carry out experiments to arrive at scientific results	X	X	X	
C.1. Students will successfully apply computing tools to problems	X	X	X	
C.2. Students will communicate well, orally and in writing, in a scientific context	X	X	X	

C.3. Students will be able to use laboratory devices and electronics in scientific applications	X	X	X	

2. How will learning outcomes be assessed?

A. What:

i. *For each SLO, briefly describe the means of assessment, i.e., what samples of evidence of learning will be gathered or measures used to assess students' accomplishment of the learning outcomes in the three- year plan?*

All SLOs are assessed in each of the three assessment tools described here. These are based on tools we already employ or have recently employed for our own assessment purposes. They focus, in turn, on narrower course-specific, broader programmatic, and more practical, post-degree educational (and employment) goals, although there is some overlap. Obviously, significant and valuable assessment of our programs and students is carried out in other formal and informal ways less well matched to the University's current assessment effort. The forms used are included as Appendices.

- Assessment by the instructors (Instructor Reports) of critical 300 and 400 level courses for all students in our major programs. The instructors specifically assess students on the SLOs identified above, as appropriate for the class in question. This is carried out at the end of every semester. The department has a well developed advising system in which each major is required (by means of an advisement registration hold) to meet with a faculty advisor at the end of every semester in order to discuss how well the student is doing, to form plans for next semester, and to receive advice on research opportunities, graduate schools, and employment. The assessment by instructors is one of the tools that informs these sessions. This tool will now be expanded to cover all 300 and 400 level courses. This is our primary assessment tool.
- Exit Interviews given to all graduating seniors. Here we gather feedback from our students on our major programs and also information on their immediate plans after graduation (allowing us to assess the frequency with which they succeed in applying to graduate school or for a job, and the quality of the graduate school or employment).
- Tracking of our graduates. We have in the past sent out email questionnaires to our alumni five years after they graduated, and we will resume this effort. Through these Alumni Questionnaires, we collect information on where they are now (employment, graduate school, etc.) and how they felt their major program prepared them for their current goals (with details about individual classes, skills, etc.).

ii. *Indicate whether each measure is **direct** or **indirect**. If you are unsure, then write "Unsure of measurement type." There is an expectation that at least **half of the assessment methods/measures will be direct** measures of student learning. [See attached examples of direct and indirect measures.]*

Instructor reports are direct assessment and form the majority of our assessment effort. Exit Interviews and Alumni Questionnaires are indirect.

iii. *Briefly describe the **criteria for success** related to each direct or indirect means of assessment. What is the program's performance target (e.g., is an "acceptable or better" performance by 60% of students on a given measure acceptable to the program faculty)? If scoring rubrics are used to define qualitative criteria and measure performance, attach them to the plan as they are available.*

To create an assessment report, the Department's Undergraduate Committee (UGC) will synthesize the results from these three tools. For example, in the Instructor Reports, instructors are asked to assess how well each student has demonstrated mastery in the area of ability to use laboratory devices and electronics relevant to their class, based on his/her performance in the class. In Part D of the Report, instructors rate each student on a scale of one to five in seven areas that cover our broad educational goals, and provide comments if noteworthy. The UGC will form averaged results, and judge the scores as follows. A score between four and five indicates excellent ability for that outcome in that class. A score between three and four indicates satisfactory ability. A score below three indicates a possibly significant problem in that skill area for that class that may require attention. Scores will be compared with ones for other learning goals in the same class, and with scores for similar learning goals in other classes, to look for broader trends, also taking into account comments provided in other parts of the Instructor Reports.

As an example of a scoring rubric, below is a hypothetical table that would be used to assess the outcome of ability in experimental and technical skills, from relevant 300 and 400 level classes.

Assessment Outcomes for Ability to Use Laboratory Devices and Electronics

	No. students	Semester	Instructor	Avg. Score
Physics 302 – Optics	8	Fall 07	Diels	2.6
Physics 307L – Junior Lab 1	22	Fall 07	Koch	4.0
Physics 308L –Junior Lab 2	20	Spring 08	Koch	3.8
Physics 476L –Exp. Techniques of Optics 1	7	Fall 07	Thomas	2.5
Physics 477L – Exp. Techniques of Optics 2	7	Spring 08	Thomas	2.8
Physics 493L – Contemporary Physics Lab	22	Spring 08	Schwoebel	4.2
Astro 426 – Optics and Instrumentation	8	Spring 08	McGraw	3.5
Average				3.6

From this example we would infer that our majors' overall skills are satisfactory to excellent, but not in the area of optics. The UGC would then diagnose the issue with the relevant instructors and together (if the pattern persists, see below) recommend changes to the program to the Department.

Exit Interviews will be analyzed to determine, for example, the fraction of our BS graduates accepted to graduate school, and the fraction of graduates looking for jobs who have received offers. Students' responses in Parts 1 and 2 are placed on a one to five scale by the advisor, and will be

assessed according to a scoring rubric as above. For instance, the third, fourth and fifth questions in Part 1 assess the area of experimental and technical skills. Feedback from the students as to the quality of the program will also continue to be synthesized.

The Alumni Questionnaire also generally features questions on the same numerical scale, again relating to our stated goals, and these will be assessed in a similar way to the Instructor Reports. Statistics on the situation of our alumni five years after graduation will also be collated.

B. Who: State explicitly whether the program's assessment will include evidence from all students in the program or a sample. Address the validity of any proposed sample of students.

For Instructor Reports, evidence will be gathered for all majors. For Exit Interviews, from all graduating seniors. For Alumni Questionnaires, from students who graduated five years previously who we are able to contact.

3. **When will learning outcomes be assessed? When and in what forum will the results of the assessment be discussed?**
   [Briefly describe the timeframe over which your unit will conduct the assessment of learning outcomes selected for the three-year plan. For example, provide a layout of the semesters or years (e.g., 2008-2009, 2009-20010, and 2010-2011), list which outcomes will be assessed, and which semester/year the results will be discussed and used to improve student learning (e.g., discussed with program faculty, interdepartmental faculty, advisory boards, students, etc.)]

As is already occurring, the UGC will be the body responsible for collecting the assessment reports and analyzing them to identify problem areas that may point to a change the degree program; major changes will be recommended by the UGC to the full faculty for approval. The information will be reviewed, a summary report written, and this report presented to the faculty on an annual basis, while changes will be considered after aggregation of three years worth of data, unless a pressing need for faster action is evident. In this way, a positive feedback loop is maintained.

4. **What is the unit's process to analyze/interpret assessment data and use results to improve student learning?**
   Briefly describe:
   1. *who will participate in the assessment process (the gathering of evidence, the analysis/interpretation, recommendations).*
   2. *the process for consideration of the implications of assessment for change:*
      a. to assessment mechanisms themselves,
      b. to curriculum design,
      c. to pedagogy
      ...in the interest of improving student learning.
   3. *How, when, and to whom will recommendations be communicated?*

As mentioned above, the UGC will lead the assessment process, but with input from other faculty involved in teaching the relevant courses. The UGC is responsible for gathering the evidence, leading the analysis, and creating recommendations. As a result of such discussions, any significant recommended changes will be presented by the UGC to the full faculty for discussion and approval. This will occur every three years, unless more urgent modifications are deemed necessary.

Appendices – Instructor Report, Exit Interview form and Alumni Questionnaire

Appendix 1 – Instructor Report

Report Form to fill out for each undergraduate major in your class. In part D, please give a numerical assessment of the student's current status on each of those areas---from 1 (quite bad) to 5 (excellent), with 3 as a large and respectable middle-ground category. Please try to provide comments for the categories listed in part D if possible.

Student's Name:

A. Describe outstanding aspects of the student's performance, and comments about student's current overall knowledge of the course material.

B. Recommendations that might benefit the student in the future.

C. Pertinent background information which might have impacted the student's performance.

D. Numerical assessment and any further comments for the following categories:

a) Overall knowledge of physics, astrophysics and/or optics relevant to the course.
To what degree has the student: demonstrated an understanding of concepts of physics, astronomy and optics, as appropriate; shown understanding of the interplay between theory and experiment; exhibited curiosity and enthusiasm for learning science?

b) To what degree has the student demonstrated an ability to analyze problems?

c) Mathematical reasoning. To what degree has the student demonstrated mathematical ability (in areas such as integration, differential equations, linear algebra and vector calculus, as appropriate) to solve problems?

d) To what degree has the student demonstrated curiosity and enthusiasm for learning?

e) How well does the student communicate orally and in writing?

f) (if appropriate) To what degree can the student successfully apply computing tools to problems?

g) (if appropriate) To what degree is the student able to carry out experiments and to use devices and electronics?

E. The actual letter grade you assigned the student: