INTRODUCTION

In a traditional physics curriculum like the one at UO, the core subject areas are:

1. Mechanics, including elements of special relativity;
2. Electricity and magnetism, including optics and electronics;
3. Thermal and statistical physics, including simple applications in various sub-disciplines;
4. Quantum physics, including atomic and subatomic structure.

Instruction in these subject areas is often approached in a "layered" fashion with typically three layers (or levels): freshman-sophomore, junior-senior, and graduate. Instruction articulating from one level to the next includes 'spiraling back,' where students see the same material (e.g., electricity and magnetism), but with increasing applicability, fewer simplifying assumptions, and as described by more sophisticated mathematics. Similarly, the lab curriculum moves from more to less guided settings, and develops more evolved skills using technical equipment, including for interfacing and computation. The quantitative nature of physics and astronomy means that a solid preparation in mathematics is an important prerequisite to these areas. The physics major requires math courses up to the level of partial differential equations and vector calculus; some courses beyond that are recommended.

Desired outcomes for UO physics baccalaureate recipients include:

- ***G1.*** Knowledge of principles and concepts for specific core subject areas listed above;
- ***G2.*** Ability to apply principles and concepts to analyze problems within specific core areas;
- ***G3.*** Capability with quantitative methods appropriate for the core areas;
- ***G4.*** Ability to analyze and interpret quantitative results;
- ***G5.*** Experience with integration of concepts: analysis of complex problems cutting across multiple core areas;
- ***G6.*** Ability to collect and appropriately analyze data working independently and in collaboration with others (experimentation; data collection, reduction and analysis; model-based computation including simulations and inversion of observations; and literature research using basic and state-of-the-art technology);
- ***G7.*** Ability to communicate orally and in writing by making appropriate use of current presentation technology;
- ***G8.*** Familiarity with current developments in physics.

CONTENT-BASED GOALS

To achieve these outcomes, the undergraduate major curriculum requires coursework with nationally-standard coverage of the core subject areas. As specific content objectives for the core areas, students who complete the department-based courses should:

- ***C1.*** have a working knowledge of classical mechanics and its application to "standard" problems such as central forces and rotational dynamics;

- ***C2.*** understand the principles of special relativity and have a working knowledge of its application to the mechanics of particles;
- ***C3.*** have a working knowledge of basic electrostatics, electrodynamics, and magnetism leading to the development of Maxwell's equations;
- ***C4.*** have a working knowledge of geometrical and physical optics
- ***C5.*** have a working knowledge of electrical circuits and their applications;
- ***C6.*** have a working knowledge of basic thermodynamic principles and the relation of statistical mechanics to them;
- ***C7.*** have a working knowledge of elementary quantum mechanics and its application to the explanation of atomic structure and atomic spectroscopy;
- ***C8.*** have basic skills in laboratory practice including a working knowledge of data analysis, computer interfacing, scientific computing, and graphical presentation of results.

OVERVIEW OF THE APPROACH TO ASSESSMENT

All physics majors take a core of physics (PHYS 251, 252, 253, 290, 351, 352, 353, 391), general chemistry (CHEM 221, 222) and mathematics courses (MATH 251, 252, 253, 256, 281, 282), generally during their first two years at the University, but some of this coursework may be completed in community colleges in preparation for transfer. Following this foundation, majors may choose one of three options to complete the major:

a) the standard physics option, which is intended to prepare students for graduate school in physics or a related discipline, and which combines advanced lecture and laboratory courses;

b) the applied physics option, which is intended to prepare students for careers in industrial research and development, and which combines some lecture courses with a heavier load of laboratory courses;

c) the general physics option, which is designed for training middle-school and high-school teachers, and which will combine some physics classes with classes in other science departments and optionally the UO School of Education.

At the undergraduate level, most assessment of the content-, skill-, and analysis-based elements of student learning are integrated within and inseparable from each assignment and examination during every term. This ongoing evaluation continuously monitors the success with which the specific courses are meeting the learning objectives for each student cohort. The course-specific data also provide information on success in meeting the integration of concepts outcome because the higher-level courses inevitably incorporate elements from other specific core areas (e.g., applications of electricity and magnetism often require analysis with principles from mechanics; descriptions of astrophysical systems incorporate the principles of electricity and magnetism and those of statistical physics).

The content-based assessments cover most of the core goals and outcomes listed above. However, a projects class sequence (Research Projects, PHYS 491, 492, 493) augments or replaces some of our existing laboratory courses and will engage the students more deeply in a specific area of physics. In many cases these projects are designed to lead to undergraduate research internships; in other cases they will serve simply to provide a flavor of what physics research is all about, for example, to better prepare future high school science teachers. In either case, these projects will provide the data for a more direct assessment of the success with which the integration goal is met for the overall program, in the form of posters, presentations or, optionally, undergraduate research papers. Also, completion of projects indicates the level of success in meeting the general goal of applying student learning to current problems in physics.

At the undergraduate level, there is more emphasis on written than oral communication. All lecture courses require completion of problem sets and all laboratory courses require written reports. The evaluation of these written materials provides data for assessing the success with which this goal is met. The Projects sequence also will include a substantial written component as well as an oral or poster presentation.

The matrix below illustrates the primary relationship of each course in the major program to the outcome- and content-based goals.

First two years:

Course	***251***	***252***	***253***	***290***	***351***	***352***	***353***	***391***
Outcome	G1-G5	G1-G5	G1-G5	G6-G7	G1-G5	G1-G5	G1-G5	G6-G7
Content	C1	C4	C3	C8	C2, C7	C6	C6	C8

Final two years including electives:

Course	***354***	***411***	***412***	***413***	***414***	***415***	***417***	***422***	***424***	***425***	***431***	***432***	***481***	***491,2,3***
Outcome	G1-G5	G1-G5	G1-G5	G1-G5	G1-G5	G1-G5	G1-G5	G1-G5	G2,G3	G2,G3	G2-G6	G2-G6	G6	G6-G8
Content	C7	C1	C3	C3	C7	C7	C7	C2,C3	C4	C4	C5,C8	C5,C8	C8	C1-C8

IMPLEMENTATION PLAN FOR ASSESSMENT

Specific Data Sources and Assessment Methods, B.S. Program: The general success of the undergraduate curriculum in guiding students who enter the program to success in meeting the learning outcomes will be assessed at course-specific and overall levels as follows:

1. At the end of each term, instructors in these courses will be asked to provide the Department Curriculum Committee, from their perspective, an overview of the course including information such as: things which worked well for this group of students; things they wish they had done differently; new ideas for material, examples, etc., to incorporate at the next offering of the course; any unusual characteristics of the particular set of students.
2. Overview information for the complete program, including the students' selected concentrations, will come from copies of the Projects class reports and an assessment of the overall work by the faculty member directing each component project.
3. A second piece of overview information comes from a web-based exit interview soliciting from alumni an overall assessment of their experience in the department: things which went well; things they wish they had done differently (for future advising purposes), things they wish the department

had done differently; things (courses, advising, student academic support, etc.) they wish the department had offered.

ASSESSMENT-BASED IMPROVEMENTS AND ADJUSTMENTS

Normally, each instructor reviews the outcome-based progress of students in individual courses as they are underway, and makes any obvious adjustments in real-time. The Physics Department's Curriculum Committee systematically reviews assessment data to identify any modifications of content and instruction, which can improve the degree to which the students exhibit success in meeting the intended outcomes. These reviews may also provide the basis for course and/or curricular modifications.

REVIEW OF ASSESSMENT METHODS

Since this document describes the Department's initial (and in some cases still developing) plan for formally assessing student learning outcomes in its degree programs, it is appropriate that the methods described above should also be assessed periodically for effectiveness and modified as appropriate by the faculty. For general education and major-sequence courses, this will be done by the Departmental Curriculum Committee.