WSU Five-Year Program Review
Self-Study

Cover Page

Department/Program: PHYSICS

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A. Brief Introductory Statement

The Physics Department at Weber State University is a dynamic department committed to meeting the needs of a growing student body and the regional community. Our strengths fit well with the mission of the university as a whole. We are active scholars in physics and physics education, textbook writers, and serve the profession by hosting and participating in regional and national meetings. One of our faculty serves as an editor of the *American Journal of* Physics and several serve as peer-reviewers. We have a commitment to teaching at the general education level and up, a strong history of undergraduate research, and impactful community outreach efforts. Exemplary efforts in the latter two areas include the HARBOR (High Altitude Balloon for Outreach and Research) and "Science in the Parks" programs.

Changes since our last review include a reorganization of our curriculum, within the physics major, into options (or tracks) emphasizing different areas of physics. These options include astrophysics, materials physics, and computational physics, and a "traditional" option. This "traditional" option was designed to be the best combination of courses for general preparation for graduate study. Brad Carroll stepped down as department chair and Dr. Inglefield took over that role.

Challenges for the department are similar to those for the university as a whole, including limited faculty time, limited funds, and the wide spectrum of preparedness of incoming students. Particular concerns recently include uncertainty in faculty positions. Several of the faculty have been reassigned to administrative positions at the university and college levels. We have not replaced the faculty member (Larson) who left just prior to the last review.

B. Mission Statement

The mission of the Department of Physics at Weber State University is to provide high-quality instruction in physics at the undergraduate level. This includes providing courses in the general education area of physical science, pre-professional and pre-engineering courses in physics, and courses and programs for those who want to major or minor in physics.

Further activities of the department include providing opportunities for research and other scholarly activities of both faculty and students, advising the students served by the department, and serving as a resource for the campus and the state of Utah in the areas of physics and astronomy.

C. Curriculum

AND

D. Student Learning Outcomes and Assessment

The Department of Physics has a standing set of learning outcomes determined for students in all classes and programs. These currently include the following, including modes of assessment and brief summaries. (Each description is given a brief name, italicized, for reference in tables.)

1. *Major Concepts*: At graduation, physics majors should have a thorough knowledge and comprehension of the core concepts of classical and modern physics, as assessed by: student success in passing the required and elective courses for their physics major; student scores on the GRE Physics Exam (in comparison with nationwide results from the American Institute of Physics and the American Association of Physics Teachers); student acceptance rates for graduate school and/or job placement; a comparison of WSU's physics curriculum with the curricula of 1) physics programs in schools with a comparable student profile, and 2) the best physics programs.
2. *Physics Skills*: At graduation, physics majors should have a set of fundamental skills that can be applied to a variety of situations. These skills should include the following:
    a. *Presentation skills*. Physics majors should be able to express (orally and in writing) their understanding of core physical principles, the results of experiments, and their analysis of physical problems, as assessed by their success in the Physics capstone presentation required of all majors and in other courses which require a written or oral report.
    b. *Laboratory skills*. Physics majors should be competent experimentalists. They should be able to design and set up an experiment, collect and analyze data, identify sources of error, and interpret their result and connect it to related areas of physics, as assessed by student performance in physics laboratory courses and faculty supervised research projects. Students should have a basic understanding of laboratory safety issues, and follow safe practices in their own laboratories.
    c. *Computer skills*. Physics majors should be competent users of basic software, such as word processing, spreadsheet, and graphing programs, and Mathematica software. Physics majors should have an understanding of computer programming and fundamental numerical algorithms as used for problem solving and visualization in the natural sciences, as assessed by student performance in the computing components of courses in the physics curriculum.
    d. *Problem-solving skills*. Physics majors should be competent problem-solvers. They should be able to identify the essential aspects of a problem and

formulate a strategy for solving the problem. They should be able to estimate the solution to a problem, apply appropriate techniques to arrive at a solution, test the correctness of their solution, interpret their result and connect it to related areas of physics, as assessed by student performance in the problem-solving components of courses in the physics curriculum.

3. *Analysis*: Physics majors should be adequately trained to apply their physics experience and knowledge to analyze new situations, as assessed by: student acceptance rates and success in academic and industrial intern positions; post-graduation student success in graduate school, industry, or teaching – in physics or otherwise – as established by questionnaires and interviews of graduates, employers, and graduate faculty. This should include a "long-term" evaluation to obtain feedback from majors of 5 – 10 years ago.
4. *Nature of Science*: All physics students (majors, minors, support, and Gen Ed students) should understand the nature of science, as assessed by exams, questionnaires, interviews, and student focus groups.
5. *General Concepts*: General Education students should understand several core concepts of physics, as assessed by nationally reviewed pre- and post-tests (for example, the Force Concept Inventory and the Mechanics Baseline Test for Newton's laws) and interviews.

   NOTE: In addition to these concepts, the Department recognizes and prioritizes the learning objectives designated by the University for Physical Science General Education Breadth requirements. We refer to these learning objectives by their shorthand descriptions: Nature of Science, Integration of Science, Science and Society, Problem Solving, Systems, Matter, Energy, and Forces. (These objectives are described fully at http://www.weber.edu/academicaffairs/natural_sciences.html.) Many of these naturally overlap with other extant Department learning objectives.
6. *Teacher Prep*: Physics Teaching majors and Elementary Teaching majors should have an appropriate knowledge of physics and a variety of teaching strategies to accommodate the multiple learning styles of their students, as assessed by a comparison of the WSU Physics Teaching major with the Utah State Core Curriculum, classroom observation of student teachers, interviews with physics teachers and pre-teachers, and job placement in major teaching field.

Assessment of our programs and courses takes place at three different levels in the Department, with strong overlap between these:

A. The Department *Assessment Committee*, designated by the Department Chair, evaluates specific pieces of our programs at its discretion and the direction of the Chair. Typical assessment efforts may focus on specific learning objectives across multiple classes (e.g., student's conceptual understandings as determined by questionnaires), student attitudes (e.g., satisfaction with and understandings gained in laboratories), and graduates' recommendations for our programs (e.g., via informal exit interviews).
B. The Department *Curriculum Committee*, also designated by the Department

Chair, evaluates the match between curricula and the needs of graduates and their potential employers. Recent efforts of the committee have resulted in our new selections of "tracks" within the Physics Major and coursework to satisfy these emphases.

C. Individual courses and their instructors are responsible for the vast majority of assessment. Each course syllabus describes measures of student learning; and individual faculty members demonstrate assessments of learning in peer reviews (for tenure-track faculty). Faculty members also describe efforts in each Annual Report in the "teaching effectiveness" section.

Along with the Department's set of learning objectives (described above), it has identified a set of direct measures and a set of indirect measures of these outcomes. These sets are not meant to be exhaustive. Abbreviations for each of these measures are indicated and utilized in our curriculum map.

Direct Measures: WE = written exams (standardized or locally-developed), OE = oral exams, LAB = laboratory activities, REP = reports/writing samples, CAP = capstone projects, IEX = inside examiners, CO = comparisons with external programs or standards, OEX = outside examiners, INT = internship experiences

Indirect Measures: EI = exit interviews, GR = graduate school acceptance, JOB = job placement, PO = participant observation, FG = focus groups, PGS = survey of post-graduation success, JP = reported job performance

Curriculum Map

The department currently offers the following coursework. Courses offering the general education "Physical Science" breadth requirement are annotated with "PS" next to the course number. Courses marked with superscript "*" are cross listed with the ASTR ("Astronomy") prefix (in addition to the PHYS prefix), a new designation since our last program review. Courses marked with a "∂" are new or revised courses (since the previous program review).

PHYS 1010 PS - Elementary Physics
PHYS 1040 PS - Elementary Astronomy*
PHYS 1360 PS - Principles of Physical Science
HNRS 1500 PS - Perspectives in the Physical Sciences (variable titles)
PHYS 2010 PS - College Physics I
PHYS 2015 - College Physics I Lab
PHYS 2020 - College Physics II
PHYS 2025 - College Physics II Lab
PHYS 2040 - Principles of Observational Astronomy*
PHYS 2090 - Environmental Physics - Energy and Power
PHYS 2210 PS - Physics for Scientists and Engineers I
PHYS 2215 - Physics for Scientists and Engineers I Lab
PHYS 2220 - Physics for Scientists and Engineers II
PHYS 2225 - Physics for Scientists and Engineers II Lab

PHYS 2300 - Scientific Computing for Physical Systems
PHYS 2600 - Laboratory Safety
PHYS 2710 - Introductory Modern Physics
PHYS 2800 - Introductory Individual Research Problems*
PHYS 2830 - Introductory Readings in Physics/Astronomy*
PHYS 2890 - Cooperative Work Experience
PHYS 2920 - Short Courses, Workshops, Institutes and Special Programs
PHYS 3160 - Stellar and Planetary Astrophysics*
PHYS 3170 - Galaxies and Cosmology*∂
PHYS 3180 - Thermal Physics
PHYS 3190 - Applied Optics
PHYS 3300 - Advanced Computational Physics
PHYS 3410 - Electronics for Scientists
PHYS 3420 - Data Acquisition and Analysis
PHYS 3500 - Analytical Mechanics
PHYS 3510 - Electromagnetic Theory
PHYS 3540 - Mechanical and Electromagnetic Waves
PHYS 3570 - Foundations of Science Education
PHYS 3710 - Nuclear and Particle Physics∂
PHYS 4200 - The Physics of Materials∂
PHYS 4400 - Advanced Physics Laboratory∂
PHYS 4410 - Materials Characterization Laboratory∂
PHYS 4570 - Secondary School Science Teaching Methods
PHYS 4610 - Quantum Mechanics
PHYS 4620 - Advanced Quantum Mechanics∂
PHYS 4800 - Individual Research Problems*
PHYS 4830 - Readings in Physics/Astronomy*
PHYS 4890 - Cooperative Work Experience
PHYS 4920 - Short Courses, Workshops, Institutes and Special Programs
PHYS 4970 - Senior Thesis
PHYS 4990 - Seminar in Physics

The learning objectives, assessment instruments, and courses all listed above have multiple intersections, as described in the following summaries, including where in which each learning objective is assessed (e.g., PHYS 2210, or another experience of a student/graduate), as well as what assessment tools are used (e.g., WE for "written exams," as coded above) to measure these outcomes.

Major Concepts:

A. student success in passing the required and elective courses for their physics major. [WE, OE, LAB, REP] *Courses*: PHYS 2210, 2219, 2220, 2229, 2300, 2600, 2710, 2800, 2830, 3160, 3170, 3180, 3190, 3200, 3300, 3410, 3420, 3500, 3510, 3540, 3640, 3710, 4200, 4400, 4410, 4610, 4620, 4800, 4830, 4970, 4990.
B. student scores on the GRE Physics Exam (in comparison with nationwide results from the American Institute of Physics and the American Association of Physics Teachers). [OEX] *Extra-curricular experience*: GRE Physics Exam.

C. student acceptance rates for graduate school and/or job placement (in comparison with nationwide results from AIP, AAPT). [GR, JOB] *Extra-curricular experiences*: application for graduate school and/or employment.
D. a comparison of WSU's physics curriculum with the curricula of 1) physics programs in schools with a comparable student profile, and 2) the best physics programs. [CO] *Courses*: PHYS 2210, 2219, 2220, 2229, 2300, 2600, 2710, 2800, 2830, 3160, 3170, 3180, 3190, 3200, 3300, 3410, 3420, 3500, 3510, 3540, 3640, 3710, 4200, 4400, 4410, 4610, 4620, 4800, 4830, 4970, 4990.

Skills:

A. Presentation skills. [CAP, REP] *Courses:* PHYS 3190, 3410, 3570, 3640, 4830, 4970, 4990.
B. Laboratory skills. [LAB, WE, OE, REP, PO] *Courses:* Phys 2219, 2229, 2600, 3190, 3410, 3420, 3640, 4400, 4410, 4800, 4970.
C. Computer skills. [WE, REP] *Courses:* PHYS 2219, 2229, 2300, 3160, 3170, 3180, 3300, 3420, 3510, 3640, 4400, 4410, 4610, 4620, 4800, 4830, 4970, 4990.
D. Problem-solving skills. [WE, REP] *Courses:* PHYS 2210, 2219, 2220, 2229, 2300, 2600, 2710, 2800, 2830, 3160, 3170, 3180, 3190, 3200, 3300, 3410, 3420, 3500, 3510, 3540, 3640, 3710, 4200, 4400, 4410, 4610, 4620, 4800, 4830, 4970, 4990.

Analysis

A. student acceptance rates and success in academic and industrial intern positions. [JP, INT] *Extra-curricular experiences:* application for summer research appointments and intern positions.
B. post-graduation student success in graduate school, industry, or teaching. [PGS, JP]

Nature of Science

A. as assessed by exams, questionnaires, interviews, and student focus groups. [WE, OE, FG, EI, IEX] *Courses:* Phys 1010, 1040, 1360, 2010, 2019, 2020, 2029, 2210, 2219, 2220, 2229, 2710, 2800, 2830, 3160, 3170, 3180, 3190, 3200, 3300, 3410, 3420, 3500, 3510, 3540, 3570, 3640, 3710, 4200, 4400, 4410, 4610, 4620, 4800, 4830, 4970, 4990; HNRS 1500

General Concepts

A. as assessed by exams, questionnaires, and interviews [WE, EI, IEX] *Courses:* PHYS 1010, 1040, 1360, 2010, 2019, 2210, 2219; HNRS 1500

Teacher Prep

A. appropriate content knowledge of physics and teaching strategies to accommodate diverse learners as assessed by a comparison of the WSU Physics Teaching major with the Utah State Core Curriculum. [CO] *Courses:* PHYS 1010, 1040, 1360,

2210, 2219, 2220, 2229, 2300, 2600, 2710, 2800, 2830, 3160, 3170, 3180, 3190, 3200, 3300, 3410, 3420, 3500, 3510, 3540, 3570, 3640, 3710, 4200, 4400, 4410, 4570, 4610, 4620, 4800, 4830, 4970, 4990.

B. *Extra-curricular experience:* student teaching and interviews with physics teacher candidates. [EI, PGS, PO]
C. *Extra-curricular experiences:* job placement and experiences in the teaching profession [JOB]

Analyses of Learning:

General Education Courses

Several courses offered by the Department fulfill the Physical Science Breadth requirement for General Education. These include PHYS 1010, 1040, 1360, 2010, 2210, and HNRS 1500. Instructors have utilized a variety of techniques in these varied courses, but they generally rely on explicit exam questions. Additionally, all of these courses except for 1010 and 1040 have dedicated lab components in which students must engage in scientific practices that model the competencies of the natural sciences (see http://www.weber.edu/academicaffairs/natural_sciences.html); and, 1010 and 1040 typically engage students in class investigations and research projects that fulfill these criteria in similar ways. In specific sections, instructors have elected to utilize other innovations in curriculum and assessment, such as investigating and discussing the history of science and societal interactions with physics research through book discussions. In all these varied settings, all passing students must demonstrate competency in these learning objectives.

Courses within the Major

For majors/minors in Physics, there is a progression of learning that takes place, in which learning in one course is assessed and enhanced in subsequent courses. A student's success in PHYS 2210 isn't just measured by the final exam in this course, but by homework in an upper division course. So, in the above description of assessments, a student in one of our programs is demonstrating competency not just once but in a progression of subsequent, building understandings. In our majors, the capstone of any student's program is in his/her presentation of research at an advanced level (PHYS 4990). In this course we get to both publicly present a student's multiple understandings and skills.

High Impact or Service Learning

The Department and its programs emphasize "high impact" learning opportunities at multiple levels. The most clear demonstration of this may be found in students' individual research projects (often conducted for credit in PHYS 4800 and presented in seminar in PHYS 4990, but not always) that are conducted with mentoring from faculty in the department. Students in PHYS 3410 have explicit assignments to demonstrate electronics concepts to 5th graders in a local school, and preservice teachers in PHYS 4570 must works with students and parents to help mentor science fair projects at another local school. Finally, the Department faculty model service to the community through its

annual Open House, which incorporates volunteers from most of our majors. Primarily, this event is meant to build a relationship with the community, but we've learned that it also builds a community within and allows students to demonstrate multiple program learning outcomes in a public venue.

Assessment Summary and Discussion

The Department has made great effort to be clear about its intended learning outcomes, as well as to be deliberate about their emphasis and assessment. At the same time, we recognize that we will be reevaluating these in the near future. There are several pieces contributing to this expectation:

A. The Department's new "options" within our Physics Major (Traditional, Materials, Astrophysics, and Computational), in addition to our Applied Physics and Physics Teaching majors, create a new opportunity to understand our students' paths towards graduation, future schooling, and employment. We have additional emphases and courses that have been built with students needs in mind, with the guidance of other program examples, and especially with consideration for our own sets of expertise and skills as scientists.
B. The set of learning outcomes we describe were put into place in January of 1999. While there has been consensus that none of these objectives seem out of place, they are also admittedly worth revisiting.
C. For the past four years we have been represented (first by our Department Chair, currently by our Assessment Committee Chair) in what is known as "Tuning." Physics departments from the entire state of Utah are represented in the Tuning process, and the Board of Regents (with grant funding from the Lumina Foundation) has sponsored an ongoing discussion of physics curricula, learning outcomes, and assessments. This process is ongoing, but as it develops it can give the Department additional input on student preparation and assessment techniques.

Due to the intersection of these factors, we anticipate that we are entering an era to reconsider our learning objectives and our assessment measures.

In the process of creating this self study document, the Department recognized that its ongoing evaluation practices and assessment tools were slightly incongruent with templates suggested by the University Office of Institutional Effectiveness. In addition, the Department feels strongly that it can implement and document better, more authentic tools to measure its intended outcomes than what might be the tradition. Given the support and push from the Office of Institutional Effectiveness, ongoing development of measurement tools from the Tuning Project, and the Department's own interest in documenting what it believes it does well, we are proposing the following steps towards revamping its assessment effort:

1. Revisit our current stated learning outcomes and revise, as necessary. Considerations of other lists, such as the Tuning Project, the University's own General Education objectives and mission statement, and other sources will also be made.

2. Document assessment practices, both formative and summative, that instructors already implement. These should not be limited to traditional exams and assignments, but may also include tools often neglected, such as whole class discussions, oral exams and interviews, attitude surveys, student reports, etc.

3. Compile a database of existing tools and cross reference these with our learning objectives. Where a learning objective is indirectly measured by a tool, work can be done to validate the measure by conducting a small scale study. For example, an instructor's impression of a class discussion and what it reveals about student understandings of the "nature of science" (a physical science general education objective) can be validated by exit interviews with a few students.

4. Maintain a department set of assessment resources and examples. (Many faculty continue to have peer reviewed tools from their professional file that could be used to contribute to such a resource.) Expand this collection of tools as faculty continue to implement new methods and attach them to specific learning outcomes.

E. Academic Advising

Advising Strategy and Process

Advising is done primarily by the department chair for the physics and applied physics majors and by Dr. Johnston for the physics teaching major. Advising within the department is done by faculty rather than staff. This is accomplished through an introductory discussion at the time of major declaration and follow-up meetings. There is no mandatory advising policy.

At the beginning of every school year, a "Welcome Back" letter is sent to all physics majors encouraging them to meet with their advisor, and informing those in their final year of the process involved in preparing for their senior seminar. An email list of physics majors has been compiled to notify students of important events and deadline, such as those for scholarship applications and Graduate Record Exams. The list is updated regularly. The Department has offered advising seminars on careers and graduate study, typically every year as part of its weekly seminar series.

Along with formal advisement efforts within the Physics Department, the College of Science also has an office for general advisement. Jane Stout is responsible for advisement regarding general education. In addition, she makes recommendations to the Dean of the College of Science regarding general education waiver requests in life and physical science. The advisors in the Physics Department will often refer program majors and minors to Jane when specific questions arise regarding general education degree requirements. Jane refers questions regarding course articulation for transfer students to the Chair. This past summer Jane Stout and chairs from various departments within the COS held orientation sessions for incoming students with COS majors.

Effectiveness of Advising

The advising process within the Physics Department is evaluated through data collected via the anonymous exit surveys required of all graduating seniors. One of the questions asked in that survey directly addresses the advising process: "What comments do you have about advisement you received regarding: (a) Course selection and scheduling?, (b) Career goals?, (c) Help in obtaining employment and/or graduate school placement?" The results for (a) indicate that many students have obtained little or no schedule advising simply because they have not sought it. (One student answered, "I didn't receive much advisement, nor did I look for much, but when I did it was there.") As noted above, students are provided with a sound introduction to the department when they sign up as physics majors, and many students feel they do not need additional help with their scheduling, despite the yearly invitation in the "Welcome Back" letter to visit their advisor. The results for (b) indicate that as students near graduation, they rely on the faculty with whom they have worked for help and advice on their post-graduation plans. The results for

(c) demonstrate the need for additional resources for career employment and graduate school advisement, both within the Department and through Greg Nielson's office in Career Services.

Past Changes and Future Recommendations

The curriculum has recently undergone changes that altered the sequencing of courses and the requirements within the Physics and Applied Physics majors. The department curriculum committee has been tasked with providing updated course sequence information for advisees and make recommendations to the chair regarding advising and course semester offerings.

F. Faculty

Faculty Demographic Information

For the 2012-13 academic year, the Physics Department has 12 tenured faculty and 1 visiting faculty position. One of the tenured faculty (Dr. Ron Galli) is on a ¾ time appointment, and one other (Dr. Walther Spjeldvik) is on ½ time appointment. As a result the Department has 12.25 FTE faculty positions as of the 2012–13 academic year. Dr. Tabetha Hole is on a full-time visiting (non-tenure-track) appointment.

It is worth noting that one faculty member (Dr. Brad Carroll) has indicated that he will be going to a ½ time appointment as of fall 2013, and the visiting faculty position is not a permanent faculty position at this time. In addition, the future status of Dr. Dale Ostlie (former College of Science dean) is unknown.

The Physics Department faculty have had numerous special reappointments within the Department, College of Science and external to the university. At present, these include the Department Chair (Dr. Colin Inglefield) with a 0.5 FTE reassignment for administrative duties, the Planetarium Director (Dr. Stacy Palen) with a 0.25 FTE reassignment, work for the College of Science Dean (Dr. Dale Ostlie) with a 0.5 FTE reassignment, director for the Center for Science and Math Education (Dr. Adam Johnston) with a 0.5 reassignment (in addition, a significant portion of Dr. Johnston's teaching load is within courses for teaching majors that are cross-listed with other COS departments), Science Fair coordinator (Dr. John Sohl) with 0.16 reassignment, Associate Editor for the American Journal of Physics (Dr. Dan Schroeder) with a 0.6 reassignment and an additional 0.25 FTE department commitment to the Honors program to teach two courses of HNRS 1500 per year. The current total reassigned time for the department is 2.76 FTE.

The Department of Physics has a strong group of faculty with a broad range of backgrounds in physics and astronomy. These diverse academic backgrounds complement one another and provide excellent opportunities for our undergraduate majors and minors to explore a variety of specialty areas. Areas of expertise represented by the faculty include astrophysics, astrobiology, high energy and particle physics, condensed matter physics, optics, nuclear medical physics, space physics, electronics, physics education, nuclear physics, and computational physics. Along with the various specialty areas, the Department has endeavored to provide an appropriate mixture of theoretical, computational, and experimental opportunities for our students. The curriculum vitae of the current departmental faculty are available in Appendix H.

The Department also employed two adjunct faculty members (Jacob Albretson and Orest Gogosha) on a regular basis to teach evening courses. Other adjunct faculty teach lower-division labs: Cristine Lewis, Charles Lear, and Jeanette Wilkinson and Joe Meyers.

Programmatic/Departmental Teaching Standards

Contract faculty perform the vast majority of all instruction within the Physics Department. When adjunct faculty are employed, great care is given to hire faculty who are fully qualified to teach physics at the university level as evidenced by their educational backgrounds. In addition, these faculty are also screened through an interview process to insure that they are good classroom teachers. Specifically, potential adjunct faculty are required to present a lecture to the contract faculty at the level of the course(s) they will be teaching. The Department does not employ applicants who do not meet these rigorous standards. Students evaluate the performance of adjunct faculty in every class they teach, and the Chair periodically reviews their teaching materials. If it is determined that currently employed adjunct faculty are not meeting the rigorous standards of the Department, they are not assigned to additional courses in the future.

Due to the existence of a fairly uniform curriculum, physics programs across the nation tend to establish similar expectations and standards for undergraduate education, particularly as they apply to core major and minor coursework. A small number of standard textbooks exist in each of these core topic areas, and within these texts, problems have been developed that are challenging but appropriate to the level of the course.

Along with the standardization that naturally occurs due to the common curriculum and textbooks, other factors also help to insure that appropriate teaching standards are established throughout the Department. For example, within the Department of Physics, no faculty member "owns" an individual course. Faculty are often rotated through courses on a periodic basis, allowing them to remain fresh and excited about the material being presented. In addition, faculty within the Department routinely share ideas and pedagogies in an informal way, so that individual faculty members are aware of the expectations of other faculty teaching the same or similar courses.

In multiple-section general education and service courses, faculty are encouraged to discuss textbook selection with the other faculty teaching the same course. Although academic freedom demands that textbook selection is ultimately up to individual instructors, the Department attempts as much as possible to reach a common consensus of the text(s) to be used for a specific course. This commonality of textbook selection also encourages high academic standards among the faculty of the Department.

Following a process that has been in place for a number of years, teaching schedules and service workloads are established in the Physics Department by first requesting that faculty indicate their preferences for courses and service activities. Based on the requests, the Chair then constructs teaching schedules that reflect faculty interests, expertise, and abilities to interact with specific student populations (general education, service, majors/minors). With an average load of 12 TCHs per semester,

care is taken to insure an even balance across faculty assignments. The entire department is then given an opportunity to review and comment on the assignments established by the Chair. In most cases minor adjustments can be, and have been made to satisfy specific concerns that arise. Typical concerns have included courses scheduled too close together or multiple sections of courses assigned on alternate day sequences (MWF or TTh). Over the period of time considered in this program review, this process of establishing faculty workloads appears to satisfy all concerned.

Faculty in the Department of Physics generally use traditional lecture settings (with many course/instructor-specific innovations, including discussions, interactive demonstrations, and class projects) in most of the courses taught through the Department. Of course, laboratory courses are the exception to this general statement. Some members of the faculty have experimented with supplemental forms of pedagogy, such as inquiry-based instruction, at-home laboratories, and group work in class. In addition, increasingly extensive use of online resources, such as the posting of solutions to homework assignments and examinations on course web sites, the use of computer simulations and videos produced by Weber State University faculty, and access to external informational sites on the internet are being employed.

Many faculty with the Department of Physics at Weber State University are actively involved in research and innovation in instructional pedagogy. For example, many faculty in the Department are members of, and actively involved in the American Association of Physics Teachers (AAPT) and the American Physical Society (APS). As such they routinely participate in regional meetings of, for example, the Idaho/Utah section of the AAPT and the Four Corners section of the APS. They also participate in national meetings of those organizations, where they and their students have presented numerous papers. In addition, members of the Weber State Physics faculty have also been actively involved in the leadership of the regional division of the AAPT (Drs. Farhang Amiri, Daniel Schroeder and John Sohl). One member of the Department (Dr. Daniel Schroeder) serves as the Associate Editor of the *American Journal of Physics*, a publication of the AAPT.

Along with active involvement in the AAPT, one member of the faculty (Dr. Adam Johnston) has specific research interests in physics education and is well recognized for his contributions in that area. His work has resulted in several publications in journals such as *The Journal of Research in Science Teaching* and *The American Education Research Journal*.

Along with providing a wide range of educational and research opportunities for our majors and minors, the faculty are also carefully selected to be excellent teachers. As documented in the section on "Evidence of Effective Instruction" below, many of our faculty have already received formal recognition for their strengths in teaching and physics education.

Faculty Qualifications

Department faculty all hold Ph.D.s in physics or physics education and are highly qualified to provide a first-rate education for our undergraduate students. Faculty in the Department of Physics are also able to serve as examples of faculty who are engaged and excited about their chosen field of study.

Adjunct faculty all hold degrees in physics or a related field, and undergo screening for teaching abilities during the hiring process as described in the "Teaching Standards" section above.

When opportunities arise to hire new faculty in the Department, great attention is given to selecting candidates who can enhance the Department's ability to provide the highest possible level of undergraduate education. In the future, supporting new programs and contributing to the economic development of the region may become more prominent considerations. Serving as a strong guide in this process are the formal objectives and goals that have been established by the Physics Department, and are reviewed on a regular basis.

Evidence of Effective Instruction

i. Regular Faculty

In general, faculty in the Physics Department at Weber State University have been on the cutting edge of developing and using effective pedagogical strategies in their courses. This is evidenced by the number of faculty in the Department who have been awarded or nominated for various teaching awards while at Weber State, including the Best of State University Professor, College of Science Seager Award, Lowe Innovative Teaching Award, Honors Nye-Cortez Professor, Honors Program New Professor Award, Honors Eccles Fellowship, Crystal Crest Teacher of the Year, and John S. Hinckley Award. One member of the faculty was chosen as the College of Science Endowed Scholar, in part as recognition of his mentoring of undergraduate researchers. In addition, one faculty member received the Outstanding University Science Educator (Utah Science Teachers Association) and was nominated for the 2011 U.S. Professor the Year award.

On a more systematic level, faculty within the Physics Department, and faculty across Weber State University are required to have student evaluations performed in at least two courses each year. The selection of the two courses is to be determined through consultation with the Department Chair (PPM 8-11.II.B). Copies of the student evaluations are submitted to the Chair for his/her review and evaluation, and those copies are kept in confidence in faculty files in the Chair's office. In addition, faculty within the College of Science meet with the Department Chair on an annual basis (beyond the requirement of PPM 8-11.II.A) to discuss

performance issues in general, and teaching effectiveness in particular. Copies of those Annual Faculty Reviews are also kept on file in the office of the Chair. Additionally the Annual Reviews, together with student evaluations of at least two courses per year are shared with the Dean of the College of Science.

ii. Adjunct Faculty

Although adjunct faculty do not meet formally with the Department Chair on a systematic basis, they are also required to have their teaching effectiveness evaluated through the same student evaluation process as the contract faculty. Every course taught by adjunct faculty is evaluated, and the Chair periodically reviews the teaching materials used by adjuncts.

Mentoring Activities

Physics for either new contract/adjunct faculty or new classified/professional staff, although they are encouraged to take advantage of University-wide opportunities. Given that turnover within the Department is relatively infrequent, the Department has been able to work with faculty and staff on a case-by-case basis. This informal process involves ongoing conversations with the Department Chair and with other faculty within the Department.

A formal process of orientation has been instituted at the University-wide level for new faculty. Annually a New Faculty Retreat has been held to provide valuable information about the institution, as well as teaching strategies that more seasoned faculty have found useful.

Diversity of Faculty

Physics and astronomy have struggled to attract underrepresented populations into the discipline. Unfortunately this problem has been and continues to be more severe in physics and astronomy than in any other field of science. According to recent statistics from the American Institute of Physics (AIP Publication Number R-430.02, February 2005), in 2002 only 14% of faculty positions in undergraduate-only institutions were held by women, and only 7% of faculty positions at Ph.D. granting institutions were held by women. These data are consistent with the current rate of production of female Ph.D. physicists at 14% of all degrees earned in 2001-2002, which has risen slightly in recent years.

Similar rates of under-representation exist by race and ethnicity. According to AIP Publication Number R-392.6 (December 2005), only 2.0% of physics faculty in the United States are African-American, 10.6% are Asian, 2.7% are Hispanic, 82.2% are White, and 2.2% are Other.

Only one member of the current faculty is classified as minority (Asian), and three members are female. The Department's diversity has increased in the last decade, but Weber State University faces the same difficulties in attracting minority and female faculty as other departments across the nation. In previous faculty searches relatively few highly qualified female or minority candidates have applied. As the diversity of the Department increases, we anticipate that prospective minority applicants will view the Department favorably.

Ongoing Review and Professional Development

Ongoing training and development opportunities exist at several levels. There are many in-house opportunities for faculty, such as the Teaching and Learning Forum and the Hemingway New Faculty grants. Workshops on various aspects of WSU faculty life may be scheduled on eWeber's Training Tracker. All faculty are encouraged to participate in regional and national meetings in their various areas of expertise. The faculty are also encouraged to actively engage in research and scholarship activities as a means of remaining current in the rapidly progressing and evolving disciplines of physics and astronomy.

The Department Chair reviews all contract faculty and classified/professional staff on an annual basis. The annual review of contract faculty is conducted in a systematic fashion within each department in the College of Science. During the Spring Semester, each faculty member is required to complete an Annual Faculty Review of his/her activities in the areas of teaching, research and scholarship, and service. Each faculty member is also required to attach at least two summaries of student evaluations conducted during the past year. The Annual Review is then discussed during a meeting with the Chair. The Chair also evaluates progress made toward goals set the previous year, and works with the faculty member to establish goals for the coming year. The Chair summarizes his/her evaluation of the faculty member on the Annual Review document, provides a copy to the faculty member, keeps a copy for departmental files, and shares a copy with the Dean of the College of Science.

In addition to annual reviews, tenure-track faculty and tenured faculty below the rank of full professor are also extensively evaluated through a university-wide procedure for progress toward tenure and/or advancement in rank. The candidate is evaluated by the Chair near the end of his/her second year of service to the institution. In the third and sixth years, and at the time of application to the rank of full Professor, the candidate is also evaluated by a peer review committee (which examines the candidate's teaching materials), a departmental rank and tenure committee, a College of Science rank and tenure committee, and the Dean of the College. All candidates are evaluated in the areas of teaching, scholarship, and service, using the evidence developed by the peer review committee and contained in the candidate's professional file. In cases of dispute over evaluations at various levels of the process, the Provost will also participate in the review process. An additional University-wide

committee may also evaluate certain petitioned cases. Full details of the University's tenure and promotion process are available in the Policy and Procedures Manual, Section 8.

The formal process of annual faculty reviews also seems to be quite successful. These important checkpoints help to identify potential areas of concern for faculty in tenure-track positions and also provide opportunities to discuss current and anticipated future activities with tenured faculty. These annual conversations also provide the Chair with important feedback on the health of the Department by providing faculty with a systematic way to address concerns that they might have about such issues as how the Department is managed. Overall, the peer-review and annual evaluation processes continue to provide evidence of a highly-engaged and exceptional faculty.

G. Support Staff, Administration, Facilities, Equipment, and Library

Adequacy of Staff

In support of its academic programs, the Physics Department employs a secretary (Nereyda Hesterberg, classified staff). The Department also employs a laboratory manager (Rick Schroeder, professional staff). The Ott Planetarium employs two staff members, Ron Proctor and Amy-Jo Proctor, for program development and coordinating outreach activities (professional staff). Additional details are available in Appendix C.

Classified and professional staff are also reviewed on an annual basis. In the Performance Review and Enrichment Program (PREP) the staff are asked to perform a self-evaluation, identifying strengths and weaknesses. This self-evaluation is then shared with the Department Chair who discusses his/her evaluation of performance over the past year. As with the departmental and college Annual Faculty Reviews, the staff are asked to establish goals for the coming year in consultation with the Chair.

The Department's support staff is barely adequate in both quantity and background to support the needs of the physics program. In particular, it is difficult to support the needs of large lecture courses in the morning while maintaining lab equipment being used throughout the day while equipment in both areas tidy and accessible. Consequences include disruptions to lectures and broken or missing equipment causing delays in lab. If we do get a new science building, lectures and laboratories will be further separated in space, which would exacerbate the problem.

i. Ongoing Staff Development

The secretary continually develops and enhances the necessary skills for her position by continually learning about new office software tools (word processing, spread sheets, scanners, and web authoring tools). The secretary also strives to maintain her proficiency by receiving training for updates in administrative software systems, specifically Banner. On-campus and on-line workshops are available to aid in this process.

The laboratory manager must remain up-to-date in new laboratory technologies, and be prepared to help set up and repair lab and research equipment as needed.

Planetarium staff have taken courses at other institutions and at WSU (Ron Proctor is currently a student in the M. Ed. Program at WSU) to further the development of planetarium shows and other outreach programs.

Adequacy of Administrative Support

The Administration is appropriately supportive of the physics program. The department's budget is adequate to maintain the physics program at its present level of operation.

In the past two years the College of Science has experienced several changes in personnel, such as a new dean and several new department chairs (including the Physics Department). This has resulted in some discontinuity in procedures and loss of "institutional memory" for how things have progressed through the past.

The Office of Sponsored Projects has the responsibility of assisting faculty across the institution with obtaining and managing external grant programs. Five years ago there appeared to be serious problems with how OSP functioned. Communication and coordination among OSP, the PIs on grant, and other campus offices (such as Purchasing) were problematic and at times dysfunctional. With some new hires in the Office of Sponsored Projects, this has improved somewhat, and the department hopes that this positive trend will continue.

There have been difficulties coordinating efforts between the Physics Department and Purchasing. Two recent purchases (an atomic force microscope and a radioactive source) have been particularly difficult due to the procedures of the Purchasing Department in regards to large equipment purchases and dealing with international sellers. As Weber State and this department grow their research endeavors the number of such purchases will most likely increase.

Along with funding for software and equipment to support educational and research projects, the Physics Department has been fortunate to receive generous donations from private sources and through University tuition waivers to provide financial support for many of our majors as they progress through their undergraduate careers. To date, the Department is able to provide support through the following scholarship, fellowship, and tuition waiver programs:

Jim Bateman Scholarship
College of Science Beishline Computer Application Fellowship
The Pope M. & Grace C. Burkhart Undergraduate Research Fellowship
Mary Margaret Clarke Scholarship
J. Ronald and Cheryl M. Galli Scholarship
H. Paul Huish Scholarship
Questar Corporation Scholarships
Physics Department Activity Fellowship
Planetarium Activity Fellowships
Paul and Carolyn Thompson Research Fellowship
WSU Undergraduate Research Fellowship

Additional scholarships and fellowships are also available through the College of Science and the University.

The Physics Department supplements its lower-division laboratory budgets (a portion of the current expense budget) through laboratory fees of $25 per semester. This source of revenue is vital to maintaining current laboratory programs, and has provided the opportunity for future upgrades. Equipment for general education courses (PHYS 1010 and 1040) are supplemented by $10 lab fees per student.

Adequacy of Facilities and Equipment

Through the process of obtaining other financial resources from the University and through external granting agencies, it has been possible to develop and maintain basic programs within the Department. However, as undergraduate research activities continue to expand, additional funding will become increasingly important. At the present time we are able to provide our students with access to important experimental and computational resources, including a well-equipped laser laboratory, an electronics laboratory, a nuclear physics laboratory, a nuclear medicine laboratory, an atomic force microscope, an instructional scanning tunneling microscope, and a computing cluster. A large amount of additional, more standard equipment is also available for undergraduate use.

Significant resources are required simply to maintain existing equipment; additional resources will be needed in the future to replace aging equipment and provide additional opportunities for undergraduate research experiences. In 2006-07, the last of our storage space was used to create a new state-of-the-art computational physics lab and an office for adjunct faculty. This extensive remodeling was funded primarily by a $1,000,000 grant from NASA for planetarium activities. Additional funding for research computing resources is from a combination to research grants and cost sharing with the department and the Ott Planetarium.

The department's atomic force microscope (AFM), a $70 000 purchase in 2005, can not be repaired at this time due to changes in ownership of the original company. The AFM is used for undergraduate research projects and upper division laboratories within the department. At some point this piece of equipment will need to be replaced.

Most critical at the present time is the need for additional space to support our various programs. The Physics Department has two lecture rooms (LL 121 and SL 240) that are booked from 7:30 am – 3:00 pm most days. Additional lecture sections will not be possible without additional rooms. Introductory labs typically have three to four students per lab bench due to space constraints. In other words, if and when we need to offer additional sections of our large courses (for example to support a growing engineering program) we will be

unable to do so with the current model. Along with lecture and laboratory space, faculty office space is becoming critical. For several years the Department has been forced to provide office space for one faculty member in an area that was originally meant to be a small office for a laboratory manager. In addition, three physics faculty have their offices one floor above the department, with the Geoscientists. This makes the department split in terms of physical locations. As the university and the Department continue to grow, it is becoming increasingly important that this critical need be addressed.

As discussed above, when consideration is given to the availability of internal and external grants, and the future availability of laboratory fees to supplement existing legislative allocations, current funding levels for departmental equipment, travel, and general operating expenses are adequate to support the mission, objectives, and goals of the Physics Department. However, as departmental programs continue to grow and develop, additional resources will become severely strained. This is particularly true in the various areas of experimental physics. General space issues are becoming increasingly critical. The existing lecture and laboratory spaces are beginning to inhibit the Department's ability to offer the necessary number of sections of courses required to meet the current and anticipated needs. Additional office space is needed to provide our existing faculty with the necessary environment to be maximally productive. At the same time there is no additional office space available to support future expansion within the Department. Space is also important for faculty and student research programs. Although sufficient space is currently available to meet the existing needs, future program expansion will be severely limited by available space resources.

Adequacy of Library Resources

Weber State no longer has access to some key American Institute of Physics (AIP) journals (Journal of Applied Physics, Applied Physics Letters, Review of Scientific Instruments, Journal of Chemical Physics, etc.). Still, the Physics Department appears to be adequately, if not optimally, supported for its primary mission of teaching. The library is working with faculty to identify and attempt to restore access to key journals to support teaching and research efforts. The Department is allotted an adequate budget for buying new books, and the library's interlibrary loan program works very well, providing any book or journal article needed within a matter of days. JaNae Kinikin, the Science Librarian, works effectively to keep the faculty up to date on new library technologies and opportunities.

H. Relationships with External Communities

Description of Role in External Communities

The faculty of the Physics Department have numerous professional relationships with a wide variety of external communities, ranging from local businesses and organizations to national and international agencies and organizations. These relationships are summarized in Appendix E.

- Utah Grid: Dr. John Armstrong serves on the Utah Grid Committee, an initiative with the University of Utah, Utah State, Southern Utah University, Utah Valley State College, and industry partners to integrate Utah's high performance computing infrastructure.

- NASA's Astrobiology Institute: Dr. John Armstrong heads the code integration team for the institute's Virtual Planetary Laboratory, and interdisciplinary planetary modeling team.

- McMaster University (Hamilton ON, Canada): Dr. Michelle Arnold has worked with a colleague at McMaster on a project, "Sustainable use of lead in Ontario and other developed economies: assessing knowledge gaps and determining evidence based strategies to minimize health impact." WSU belongs to an international consortium to research the health impact of lead.

- Mount Sinai School of Medicine (New York, NY): Dr. Michelle Arnold participated in a Mount Sinai project to standardize the technique of x-ray fluorescence to study the lead content of bone.

- Iguana, Inc. (Carnelian Bay, CA): Dr. Carroll serves on the Board of Directors of Iguana, Inc., the maker of Iguanaware software for project management.

- Thiokol Propulsion: Dr. Colin Inglefield worked with Thiokol Propulsion on the atomic force microscope characterization of HTPB rocket propellants.

- National Renewable Energy Laboratory and the Colorado School of Mines: Dr. Colin Inglefield has worked with collaborators at these institutions on the microstructure on amorphous/microcrystalline silicon and the phase change alloy system GeSbTe.

- Utah State Office of Education: Adam Johnston is a member of a science curriculum leadership team to plan K-12 science curriculum and professional development for inservice teachers.

- Partnership for Effective Science Teaching and Learning (PESTL): Adam Johnston consults and instructs in this professional development program for elementary teachers in Utah.

- Science Education at the Crossroads: Adam Johnston is co-creator and organizer for this national science education conference (sciedxroads.org).

- DaVinci Academy of Science and the Arts: Dr. Adam Johnston is a former member of the Board of Directors of DaVinci Academy, a public charter high school.

- Clark Planetarium: Dr. Stacy Palen and Dr. John Sohl have an ongoing relationship with the Clark Planetarium.

- Audio-Visual Imagineering (Orlando, FL): Dr. Stacy Palen works with Audio-Visual Imagineering to distribute planetarium content around the country.

- Challenger Learning Center (Hammond, IN): Dr. Stacy Palen is collaborating with the learning center on an assessment of K-8 educational module content.

- Dr. Palen and her staff collaborate closely with planetariums all over the country, teaching workshops, on-site classes and tutorials, creating unique visualizations, formatting shows, and trading or selling content. These relationships encompass planetariums in 26 states and 17 countries.

- National Optical Astronomy Observatory, United States Naval Observatory, and the National Radio Astronomy Observatory: Dr. Stacy Palen works with colleagues at these institutions on surveys of planetary nebulae.

- Konica-Minolta (Japan): Dr. Stacy Palen collaborates with Konica-Minolta to distribute planetarium content developed at WSU with their planetarium projectors.

- *American Association of Physics Teachers*: Dr. Dan Schroeder serves as an editor of the *American Journal of Physics,* published by AAPT.

- RSGA International: Dr. John Sohl worked with RSGA International to create and patent (pending) the Firefly Tent Light. (The patent rights will be owned by RSGA International.)

- Leonardo (Utah Science Center): Dr. John Sohl has worked on several of the center's exhibits.

- Children's Gateway Discovery Museum: Dr. John Sohl contributed to an exhibit at the museum.

- National Mountain Rescue Association: Dr. John Sohl has been involved in studies on the physics of hypothermia and snow science with the NMRA. Odyssey Elementary (Ogden City School District magnet school): Dr. John Sohl served on the advisory board for development of the school's mission and building.

- Los Alamos National Laboratory: Dr. Walther Spjeldvik has worked with the Space Research Section of Los Alamos.

- Boston University: Dr. Walther Spjeldvik has collaborated with colleagues at Boston University.

- Caltech: Dr. Walther Spjeldvik has collaborated with Caltech's Downs Laboratory on the project SAMPEX spacecraft to detect positrons in space.

- NASA's Jet Propulsion Laboratory: Dr. Walther Spjeldvik has collaborated with the JPL's Division of Planetary Sciences.

- RIKEN (Tokyo, JP): Dr. Walther Spjeldvik has worked with RIKEN's Cosmic High-Energy Physics Laboratory.

- Lawrence Livermore National Laboratory: Dr. Walther Spjeldvik has collaborated with the Space-Radiation Monitoring Section of LANL.

- ONERA-DESP-CERT (Toulouse, FR): Dr. Walther Spjeldvik has collaborated with the Space Research Laboratory, part of the Department of Defense of France.

- University of Campinas (Campinas, BR): Dr. Walther Spjeldvik has worked with colleagues in the Physics Department at UniCamp.

- Space Research Institute of the Russian Academy of Sciences (Moscow, RU): Dr. Walther Spjeldvik has collaborated with the Institute for Cosmic Investigations.

- NASA: Dr. Walther Spjeldvik has worked with the Division of Magnetospheric Physics.

- Instituto Nacional de Pesquisas Espasiais (Sao Jose Dos Campos, BR): Dr. Walther Spjeldvik has worked with the Brazilian Space Research Institute.

- Belgian Institute of Space Aeronomy (Brussels-Uccles, BE): Dr. Walther Spjeldvik has worked on electromagnetic wave investigations with BISA.

- Charles Stark Draper Laboratory (Cambridge, MA): Dr. Walther Spjeldvik has collaborated with the Antimatter Research Division of the laboratory.

- NASA Institute of Advanced Concepts: Dr. Walther Spjeldvik has worked with NIAC.

- Science Journals International: Dr. Walther Spjeldvik is a member of the editorial board of *Physical Sciences*, an electronic journal.

The Department's outreach effort includes many audiences, and involves departmental personal going out to these communities, as well as bringing the communities to Weber State. For example, the Department created its first Physics Department Open House in April, 2007. The demonstration shows, lectures, physics activities and planetarium shows were a resounding success. The department has now had six annual Open Houses, brining anywhere from 300 – 1000 people to the campus for each.

The Physics Department's Ott Planetarium is responsible for most of the Department's outreach activity. The Ott Planetarium performs outreach of five basic types:

1. Faculty members routinely visit high schools and grade schools, work with teachers and school boards in northern Utah, and host visits from interested students to the Department. The planetarium also serves as a general information resource for public questions related to astronomy.

2. Students from regional schools (as far away as Salt Lake, Southern Idaho and Western Wyoming) come to the Ott Planetarium for field trips. The planetarium has tailored its shows to the Utah K-12 Core Curriculum, so that teachers use this experience to complement their classroom instruction. In 2011 more than 12,000 K-12 students have visited the planetarium on field trips or for astronomy merit badge programs. Planetarium shows were created in Spanish to reach out to local disadvantaged and Hispanic groups. The Ott Planetarium and Physics Department Observatory host Science Saturdays (once or twice a month), and collaborate with the Ogden Astronomical Society to host star parties from April through October. Over the course of the last year, approximately 6000 members of the general public have been reached through this outreach effort.

3. The Ott Planetarium produces full-dome content for small planetariums. There are more than 1,000 small planetariums in the United States, many of them located in junior high or high schools. To meet the demand for quality

shows at affordable prices, the Ott Planetarium has created twenty-three full-length planetarium shows, and a set of curriculum modules. The Planetarium has compiled a list of the core curricula of each state, so the curriculum modules can be customized to meet the specific needs of teachers in different states. Ott Planetarium productions are currently showing in 26 states, 17 countries and 7 languages. These shows are known for their quality, with "Expanded View" receiving the NASA Top Star /Gold Star award for educational content (one of only ten projects to do so over a twenty year period).

4. In 2011, 20 students worked in the Ott Planetarium. The opportunity to work in the planetarium is one that appeals to students in many different fields of study, from music majors to graphics arts to sound technology to chemistry. All of these students gain experience speaking in public, and our inclusive policy of finding out what useful skills students already have, and designing the program around the students currently involved improves the prestige of the Department and the sciences as a whole. Students from outside the sciences learn an appreciation for science that may be missing from their public school education, and students in the sciences learn an appreciation for the artistic and technical expertise required in other professions.

5. The planetarium offers training in graphic design skills. Workshops attract professionals from all over the United States, and even Australia.

6. Since the summer of 2007, Dr. Adam Johnston has collaborated with the Ott Planetarium and the Ogden City School District to create the "Ottreach: Science in the Parks," a summer program in conjunction with Ogden's free lunch program for children in the city's parks. Literally thousands of children explored the world of science in this program, many of whom come from disadvantaged communities. This has been highlighted as a particularly effective outreach program for this at-risk group on the WSU campus.

The faculty within this department have also contributed substantially to the continued operation of the Center for Science and Math Education (CSME). The staff member who ran the center left WSU in 2010. Dr. Stacy Palen received ¼ reassigned time to run the center in 2010-11, and no release time to continue with the position during 2011-12. This year (2012-13), Dr. Adam Johnston has ½ reassigned time for the CSME with the objective of enhancing support for teachers and K-12 students in the local area. The CSME is an asset to the College of Science, with approximately 45 000 people visiting each year. However, it has been a large sacrifice of the Physics Department to support the operation of the center over the past three years.

In addition to the numerous cooperative agreements between individual faculty and external communities, and the Ott Planetarium's extensive outreach

program, there are a variety of informal processes that provide valuable information and interaction with the community at large.

1. Professional Societies: The faculty within the Physics Department are members of and actively involved in a large number of professional societies. Membership in these societies enables faculty in the Department to stay current in national and international dialogs in a wide variety of areas. Societies that faculty in the Department belong to include:

< American Association of Higher Education
< American Association of Physics Teachers
< American Astronomical Society
< American Geophysical Union
< American Institute of Aeronautics and Astronautics
< American Physical Society
< Astronomical Society of the Pacific
< Committee on Space Research (international)
< International Association for Geomagnetics and Aeronomy (international)
< International Planetarium Society
< Materials Research Society
< National Association of Research in Science Teaching
< National Science Teachers Association
< Ogden Astronomical Society
< Optical Society of America
< Pacific Planetarium Association
< Phi Kappa Phi
< Rocky Mountain Planetarium Society
< Sigma Pi Sigma (National Honorary Society)
< Sigma Xi (Research Society)
< Society of Physics Students
< Utah Museum's Association

2. Our faculty also routinely attend and present papers at national and international meetings that are hosted by the various societies.

3. The American Institute of Physics is also an important source of information on employment trends and opportunities, curricular developments, enrollments and graduation rates in undergraduate and graduate programs, graduate schools, women and minorities in physics and astronomy, and various other demographic studies.

4. Center for Science and Mathematics Education: The Center serves as a resource for preservice and in-service training for grade school and secondary school teaching. Along with its formal training programs, the Center maintains NASA resource information that is available to area teachers. Additionally, the Center has offered a variety of programs for

middle and high school age students, including Science Olympiad, Science Fair, and S4 ("Science Seminars for Superior Students").

5. Career Services: Resources are available through the Office of Career Services to assist in providing information to students and departments regarding career opportunities and post-graduate education. Greg Nielson, an employee of Career Services, has specific responsibility to work with the students and departments in the College of Science.

6. University Development: The Office of University Development has primary institutional responsibility for fund raising efforts within the university. One member of the staff in the Development office, Lisa Largent, has primary responsibility for programs within the College of Science. As a part of that program Lisa interacts on a regular basis with each of the departments in the College, and meets periodically with the Chairs and the Dean of the College.

7. Office of Sponsored Projects: The Office of Sponsored Projects assists faculty across the institution in obtaining and managing external grant programs.

A variety of effective procedures are in place to provide important professional interactions between the Physics Department and local, regional, national, and international communities. These include

- interactions with educational organizations, businesses, and government and higher educational institutions. These relationships are summarized in Appendix E.

- activities involving the Ott Planetarium and WSU Observatory, as well as the Center for Science and Mathematics Education provide important interactions with various school districts throughout northern Utah, along with other communities in the general population.

- In addition, participation in national and international societies, together with databases maintained by national organizations provides important information about the status of undergraduate education, employment, postgraduate education, and demographics.

I. Results of Previous Program Reviews

Problem Identified	Action Taken
Adequately reducing the teaching credit hour requirements for faculty that are involved in significant undergraduate research projects. Justification for this change might be found through a survey of teaching loads at comparable 4 year universities. With research becoming expected of undergrads, and with larger Physics courses and labs, more time is required for mentoring, grading, etc. The department Chair should be encouraged to provide as much comp time as possible.	A new "work load" model was put forward within the College of Science to address these issues. This document is at the level of the Board of Reagents and it does not appear likely that it will be implemented in the near future.
Ensuring that the Office of Sponsored Programs provides better service for grant support. A clear policy for indirect cost return to the department needs to be created. A knowledgeable person at the college level to help with all science grants is urgently needed.	New hires within the Office of Sponsored Projects have improved the situation but there is still a disconnect between the OSP's central control yet PI's having ultimate responsibility or what happens.
Providing a full time technical person at the college level to provide support for the computer labs in all science departments. This individual must be	Matt Cain has been hired to handle IT for the College of Science.

able to deal with the customized hardware and software configurations that are common in the College of Science, which will require creation of a permanent position with that responsibility. Faculty do not have time to constantly deal with security and maintenance issues such as managing user accounts and updating computer hardware and software on top of their teaching loads	
Providing sufficient student lab space so there are not more than 2 students per lab station and there are separate labs for calculus based physics courses and trigonometry based physics courses.	This has not changed since our last review.
Adding a Mathematical Physics course for majors.	The Physics Department has reviewed its program and made several substantial changes, as reflected in the Curriculum section of this document.
Research should be required for all physics majors.	Research is required for most of the newly formed "tracks" within the department.

Students thought a seminar each year on the grad school process and industry jobs would give them several opportunities to find out more information that they needed. They would like more emphasis on preparation for the Physics GRE Topic exam.	The department has provided several seminars focusing on the topics of graduate school and opportunities in industry.

Summary Information (as needed)

J. Action Plan for Ongoing Assessment Based on Current Self Study Findings

Action Plan for Evidence of Learning Related Findings

Problem Identified	Action to Be Taken
Issue 1 The departmental learning outcomes have not been examined comprehensively since 1999.	The department assessment committee will look at this first and begin a department-wide discussion.
Issue 2 Our current assessment strategies do not seem to map well onto the particular types of data collection most convenient for the accreditation process.	We will continue to be active participants in the "Tuning" process to work with other institutions in developing objectives and assessments that are appropriate for our department and its mission. We plan to work with the Office of Institutional Effectiveness to modernize our approach to this area.

Summary Information (as needed)

Action Plan for Staff, Administration, or Budgetary Findings

Problem Identified	Action to Be Taken
Issue 1 Uncertainty in faculty positions for the future. Lack of depth in faculty areas of specialization.	Develop a plan as a department to make the case for new faculty positions that enhance our teaching and research programs with an eye toward graduates that will contribute to the economic development of the region.
Issue 2 Lack of funds for regular maintenance and replacement of equipment	Build these costs into future plans for equipment purchases.
Issue 3 Marginally adequate library resources	Continue to work with the librarian to maintain the best possible access to current and archival journals within budgetary constraints.

Summary Information (as needed)

K. Summary of Artifact Collection Procedure

As part of the process of reevaluating our analyses of learning across our curriculum, the department will be developing a comprehensive plan for artifact collection. See sections C/D and J.

APPENDICES

Appendix A: Student and Faculty Statistical Summary

	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Student Credit Hours Total	5,935	6,048	7,112	6,229	60,53
Student FTE Total	197.83	201.60	237.07	207.63	201.11
Student Majors	77	66	77	90	97
Program Graduates	11	10	11	12	11
Student Demographic Profile					
Female	18	12	13	19	21
Male	59	54	64	71	76
Faculty FTE Total	13.13	13.48	12.26	12.54	NA
Adjunct FTE	2.85	2.67	2.19	2.47	NA
Contract FTE	10.28	10.81	10.07	10.07	NA
Student/Faculty Ratio	15.07	14.96	19.34	16.56	

Note: Data provided by Institutional Research

Student Credit Hours Total represents the total department-related credit hours for all students per academic year. Includes only students reported in Banner system as registered for credit at the time of data downloads.
Student FTE Total is the Student Credit Hours Total divided by 30.
Student Majors is a snapshot taken from self-report data by students in their Banner profile as of the third week of the Fall term for the academic year.
Program Graduates includes only those students who completed all graduation requirements by end of Spring semester for the academic year of interest. Students who do not meet this requirement are included in the academic year in which all requirements are met. Summer is the first term in each academic year.
Student Demographic Profile is data retrieved from the Banner system.
Faculty FTE is the aggregate of contract and adjunct instructors during the fiscal year. **Contract FTE** includes instructional-related services done by "salaried" employees as part of their contractual commitments. **Adjunct FTE** includes instructional-related wages that are considered temporary or part-time basis. Adjunct wages include services provided at the Davis campus, along with on-line and Continuing Education courses.
Student/Faculty Ratio is the Student FTE Total divided by the Faculty FTE Total.

Appendix B: Contract/Adjunct Faculty Profile

Name	Gender	Ethnicity	Rank	Tenure Status	Highest Degree	Years of Teaching	Areas of Expertise
Amiri, Farhang	M	Asian	Professor	Tenured	Ph.D.	29	Elem. Particle
Armstrong, John	M	White	Associate	Tenured	Ph.D.	8	Astrobiology
Arnold, Michelle	F	White	Associate	Tenured	Ph.D.	11	Nuclear Medicine
Carroll, Bradley	M	White	Professor	Tenured	Ph.D.	28	Astrophysics
Galli, J. Ron	M	White	Professor	Tenured	Ph.D.	50	General Physics
Inglefield, Colin	M	White	Professor	Tenured	Ph.D.	14	Condensed Matter
Johnston, Adam	M	White	Professor	Tenured	Ph.D.	15	Education
Ostlie, Dale	M	White	Professor	Tenured	Ph.D.	29	Astrophysics
Palen, Stacy	F	White	Associate	Tenured	Ph.D.	11	Astrophysics
Schroeder, Daniel	M	White	Professor	Tenured	Ph.D.	20	Theoretical
Spjeldvick, Walther	M	White	Professor	Tenured	Ph.D.	28	Atmospheric/Space
Hole, K. Tabetha	F	White	Visiting	Non Tenure-Track	Ph.D.	1	Astrophysics
Albretsen, Jacob	M	White	Adjunct	Adjunct	M.S.	3	Astronomy
Gogosha, Orest	M	White	Adjunct	Adjunct	M.S. (EE)	4	Engineering
Kaur, Simranjit	F	Asian	Adjunct	Adjunct	Ph.D.	3	Space
Lear, Charles	M	White	Adjunct	Adjunct	B.S.	6	Labs
Zollinger, Rhett	M	White	Adjunct	Adjunct	B.S.	2	Astrophysics

Appendix C: Staff Profile

Name	Gender	Ethnicity	Job Title	Years of Employment	Areas of Expertise
Hesterberg, Nereyda	F	Other	Secretary	8	Secretary
Schroeder, Rick	M	White	Lab Manager	9	Technician
Proctory, Ron	M	White	Planetarium Production Coordinator	8	Scientific Visualization
Proctor, AmyJo	F	White	Planetarium Specialist	6	Outreach

Summary Information (as needed)

Appendix D: Financial Analysis Summary

Department	2007-08	2008-09	2009-10	2010-2011	2011-2012
Undergraduate					
Instructional Costs	1,128,585	1,171,777	1,126,556	1,160,857	1,354,410
Support Costs					
Other Costs					
Total Expense					
Graduate					
Instructional Costs					
Support Costs					
Other Costs					
Total Expense					

Note: Data provided by Provost's Office

Summary Information (as needed)

Appendix E: External Community Involvement Names and Organizations

Appendix F: External Community Involvement Financial Contributions

Relationships with external agents are detailed in Section H and in the attached Curricula Vitae (Appendix H).

Appendix G: SWOT analysis

SWOT Analysis – Strengths, Weaknesses, Opportunities and Threats			
Date: 11/12	Department/Program: Physics		
Internal Factors			
Strengths:	Ways to leverage:	Weaknesses:	Ways to Reduce:
Strong, award-winning faculty committed to quality teaching, community service and undergraduate research.	Promote our excellent faculty to recruit students to our majors and courses.	Outdated teaching and research space. Laboratory space limits research opportunities.	Be strongly involved in the design of the new building spaces.
Good relationships with other institutions in the region through (for example) participation and hosting of regional meetings.	Pursue research and teaching opportunities beyond our campus.	The department has breadth but not depth in areas of specialization.	Have a lengthy discussion about options for hiring new faculty.
Faculty and staff within the department are congenial and, with the students, have a strong sense of community.	Use students as recruiters. Invite groups to our department	Faculty are overcommitted.	Spread the service load more evenly across faculty in the department. Allow other departments to contribute service to the College in areas that have traditionally been handled by Physics.
		Room for improvement in dealing with several offices on campus (OSP, Scholarships, Purchasing)	Continue to work with these partners to improve relations. Discuss problems with other departments and the Dean.

		No clear plan for maintaining current research equipment.	Build these costs into future purchases of equipment.
External Factors			
Opportunities:	Ways to leverage:	Threats:	Ways to Reduce:
Proximity of Hill AFB and Defense Contractors.	Work with these groups to make sure we are preparing our students appropriately. Look for contract work (for example materials analysis with the SEM)	Chronically underfunded.	
		We have an aging faculty and no assistant professors.	Make the case for new faculty lines.
The University has emphasized growth in STEM fields.	Recruit more students to our major.		
A legislature and governor that seem enthusiastic about supporting higher-education in STEM fields.	Sell our program and potentially new (perhaps interdisciplinary) programs as drivers of economic development.		

Appendix H: Faculty Curricula Vitae