Academic Program Review
Physical Science

The Major

a. Overview and History of the Major

The physical sciences represent the fields of Physics, Chemistry, Geology, Astronomy, Astrophysics, Atmospheric Sciences, and Oceanography. Physical Science programs allow students to form a major by selecting courses from two or more of these fields. The physical science major is less intensive than a major in a single field, but instead provides breadth. It has been particularly suited to students interested in acquiring a background in several fields.

The B.A. Physical Science degree program was established in the 1960's. Historically majors in Physical Science were preparing for a Teaching Credential in Physical Science. Since the elimination of Physical Science from the credential program the number of majors enrolling in the program has fallen. A few majors who wish a broad based degree program in the physical sciences, but who do not require the more specialized Physics degree, select Physical Science as their major, as do some students who wish to pursue a science degree but who have not yet selected one of the specialized degree programs. Students in the latter category usually change major after taking the introductory classes.

b. Description of the Major

The physical science program does not have any special courses taught primarily for physical science majors. The students take the regular courses taught in the Astronomy, Physics, Chemistry, and Geology programs.

The lower division foundation courses for both degree programs are designed to give the students an overview of physics and chemistry, and the necessary tools, concepts, and techniques from the related fields of mathematics:

- Phys 2250/2260 General Physics I/II ***or*** Phys 2100/2110 Basic Physics I/II
- Math 1410/1420 Calculus I/II
- Chem 1100/1110 Principles of Chemistry I/II

At the upper division students have two options:

- A degree without a concentration, in which case the students selects (in consultation with an advisor) courses totaling not less than 24 units in the physical sciences and mathematics
- A degree with one of the following concentrations
    - Environmental Science

- Earth and Space Sciences
- Applied Physics

c. Units Beyond 120 for Undergraduate Program

Students entering the university as freshmen with a solid high school mathematical education can graduate within the 120 unit target.

The required units for the degree are as follows

Prerequisites to the major		28
Major courses		24
General Education Requirement	51	
less areas B1, B3, and laboratory	7	
plus WP (not currently satisfied by major)	3	
	47	47
Total		99

The remaining units are intended to allow the student to broaden his/her education in ways which suit his/her goals. These courses are agreed to between the student and his/her advisor at the commencement of studies. The majority of these units are usually taken within the physical sciences, although courses outside of the physical sciences have also been approved.

d. Recruitment

With the demise of the Single Subject Teaching Credential in Physical Science we no longer actively recruit into the Physical Sciences Program. Students who do enroll in the program are by and large interested in obtaining a degree for personal growth, interest, or promotion in current employment, but who do not require a specific degree for future employment.

e. Retention and Graduation

Retention figures for the Physical Sciences Program are artificially low, for two principal reasons:

1. The majority of students who enroll in the Physical Science Program are currently employed full time, and take a reduced load of classes. When assessing graduation rates by head count (as opposed to SCH's) these students are counted as majors for more than fours years, often six or more years, but only graduate once.
2. Relatively few majors who initially declare themselves as Physical Science majors graduate with a Physical Science degree. We actively encourage them to

switch to a different major early in their career, preferably to Physics or Geology (and so remain as majors in the department). Nevertheless for their first one or two semesters they are still counted in the statistics as Physical Science majors.

f. Innovations and use of technology

As a technologically oriented discipline we make use of technology whenever appropriate. Some of the computer technology in particular has been incorporated into our curriculum since before the previous Academic Program Review, and we continue to enhance our use of technology wherever its use is appropriate. However, we also recognize that technology can be an aid to instruction, and to the development of student skills, but should not be a substitute for direct classroom interaction.

Some of the ways in which we use technology include:

- interfacing of computers and equipment in laboratory classes.
- where possible for dissemination of course material. (The complex mathematics that is required of some classes precludes distribution over the Internet.)
- Students in laboratory classes (except Phys 1502) are required to use spreadsheet programs and/or other software programs for analyzing experimental data.
- The use of mathematical packages (Maple, Matlab, etc) has recently been incorporated into the physics major. Physical Science majors who select one or more of these course in developing their own program are also required to use these software applications.

g. Plans for the curriculum

The curriculum of the Physical Science program parallels those at other institutions which offer a comparable degree. It provides a grounding in the fundamental principles, and suits the needs of those students who desire the broad based science degree that the program offers. Most majors in Physical Science select the degree option without a concentration. The wide range of choice of courses which can be taken allows for a great deal of flexibility in designing the major to fit the individual student. Consequently, there are no plans to change the requirement.

Student Demographics

a. Statistics

Year	Number of Phys Sci Majors	Number of Phys Sci Graduates
1999-2000	8	1
2000-2001	4	0
2001-2002	6	0
2002-2003	4	1
2003-2004	3	0
2004-2005	2	0
2005-2006	3	0
2006 (Fall)	6	0

b. Diversity

The Physical Science program is relatively small for this campus. At the time of preparation of this report (Winter 2007) 4 students list Physical Science as their major. Of these, two are female, and one is a minority student (Hispanic). Comparable national figures for the Physical Science major are not available.

Resources

a. Since the Physical Science program is constructed from courses in Physics, Astronomy, Geology, Chemistry, Mathematics, and Computer Science it has no courses of its own, and so generates no SCH or FTES.

b. Faculty

The Physics faculty currently has four members, all of whom teach courses which are taken by Physical Science majors.

- Dr. Marvin Johnson, Ph. D., University of Illinois
  Biophysics (experimental)
- Dr. Ian Littlewood, D. Phil., University of Oxford
  Atomic Physics and Optics (experimental)
- Dr. Lu Rose Zhang, Ph. D., University of California Davis
  Material Science, High T_c Superconductors, Optical Materials (experimental)
- Dr. Susan Mokhtari, Ph. D., Imperial College, University of London
  Nuclear Physics, General Relativity and Gravitation (theory)

Figures for comparison with other Physical Science programs are not available. When compared with all Physics programs nationwide (regardless of whether they also offer a Physical Science degree), with four faculty members this department is smaller than the average of departments which offer only Physics degrees at the Bachelor level (5.4 faculty members per department) and substantially smaller than all physics departments (11 faculty members per department). Two of our faculty members are female, and two non-Caucasian, both percentages being well above the comparable figures for the average number of female and minority faculty members nationwide.

Coverage of expertise areas is not a critical issue in the Physical Science program. It is a broad based degree without specialization, and all faculty members are qualified to teach all the physics courses in the program. Expertise is required from faculty in other programs for those courses which broaden the students' learning experience.

During the current (2006/7) academic year we are searching for a fifth faculty member, partly justified by the WTU teaching load, and partly justified by the retirement of Dr Tai Low Chow at the end of the Fall 2006 semester.

(Added Spring 2008) The search for a fifth faculty member was brought to a successful conclusion with the appointment of Dr. Chris De Vries, Pd. D., U Mass Amherst, Astronomy (experimental).

c. Advising

All students are allocated a faculty advisor, and are mandated to receive advising before registering for the next semester.

d. Faculty Scholarship

Cutting edge research in physics is expensive, time consuming, and resource dependent. Faculty at this institution cannot compete at this level, they lack equipment money, release time, library resources, and support infrastructure such as fabrication workshops. (It is not uncommon for new faculty at research institutions to be offered start up funds of $½M.) To maintain any research or scholarly activity under these circumstances is in itself a notable achievement.

Nevertheless the faculty has been, and continues to be, active in five areas

- Low temperature superconductivity (Zhang)
- Non linear optical materials (Zhang, during a leave of absence with JDS Uniphase)
- Theoretical gravitation (Mokhtari)
- Astronomy (De Vries, experimental)
- Authoring of textbooks (Chow, recently retired) and instructional software (Littlewood)

e. Equipment

Equipment needs are the same as for the disciplines that teach the courses comprising the Physical Science program. The Physical Science program does not have equipment needs of its own.

f. Classroom space

Classroom space needs are the same as for the disciplines that teach the courses comprising the Physical Science program. The Physical Science program does not have classroom space needs of its own.

g. Physical Science courses and the GE program

There are two lecture classes with the PHSC prefix for which students can earn credit in the General Education Program (area B1). Neither has been taught in the period since the last review.

Assessment

Dr. Susan Mokhtari has been appointed the Program Assessment Coordinator (PAC) for the department, with responsibility for all the programs within the department, including the Physical Science program. Working in conjunction with the PAC committee the faculty of the physical science program have selected the first objective of the first goal of the program (students will have acquired a basic understanding of the core areas in at least two of the physical sciences) for class assessment.

a. Mission Statement

It is the mission of the physical science program

- to offer a high quality major undergraduate degree, and to foster a life long interest in science.
- to develop in our students an understanding of the fundamentals and modern applications of the physical sciences, including the terminology, core concepts, and methodologies of the disciplines.
- to develop each student's analytical thinking, problem solving techniques, and laboratory abilities.
- to prepare our undergraduate students for graduate school, a career in scientific research and development, or industrial work.
- to serve students in the rest of the university through high quality supplementary and support courses for other sciences and pre-professional programs.

- to provide majors and non-majors alike with an appreciation for the way the physical world works.

b. Student Learning Goals of the Physical Science Program

Graduates of the Physical Science Program:

- will have a comprehensive knowledge of the undergraduate physical sciences, and master material in advanced courses.
  Objectives:
  1. students will have acquired a basic understanding of the core areas in at least two of the physical sciences.
  2. students will be able to solve problems in a wide range of contexts in the physical sciences.
- will think critically in analysis of problems, including appropriate use of advanced mathematical tools.
  Objectives:
  1. Students will have an understanding of scientific method and how to apply it.
  2. Students will develop analytical skills and will be able to apply them to solve problems in the physical sciences.
  3. students will apply mathematical skills and reasoning to solve problems.
- will demonstrate the ability to work effectively in a laboratory environment, including the use of advanced technologies.
  Objectives:
  1. Students develop basic laboratory skills and become familiar with measurements and data analysis techniques used in the physical sciences.
  2. students will apply mathematical skills and reasoning to derive quantitative results on which their conclusions are based.
  3. students will demonstrate the ability to evaluate the quality and usefulness of their data in reaching a conclusion.
  4. students will use scientific software to present and analyze their data scientifically.
  5. students will learn to participate and contribute effectively as a team member in an experiment.
- will have a strong command of the nature of oral and written communication and of intra-group interactions in the traditions of the physical sciences.
  Objectives:
  1. students will communicate scientific information in writing.
  2. students will demonstrate the ability to communicate scientific information orally.
  3. students will demonstrate the ability to search and find information in the literature.
  4. students will demonstrate the ability to critically evaluate scientific communications (written or oral).
  5. students will learn to participate and contribute effectively in a team discussion on physical science.

c. Curriculum Matrix

Since the Physical Science program has no courses of its own the Physical Science program relies on the course assessment carried out by the Physics program and by other programs in the physical sciences and mathematics.