EASTERN OKLAHOMA STATE COLLEGE
PROGRAM REVIEW - 2018
PHYSICAL SCIENCES

1. REVIEW PROCESS

by Dr. M Nealon

2. NAME OF PROGRAM

Physical Science, Program code 036; HEGIS code 1901; CIP code 400101

3. CENTRALITY OF THE PROGRAM TO THE INSTITUTIONAL MISSION

This program is designed to meet needs of the individual student, in keeping with the missions of the college as defined by the Regents of Eastern Oklahoma State College, and as contained in the college catalog. Some students need preparation for transfers into a professional astronomy, chemistry, geology, meteorology, or physics program at a four-year institution, while students need various courses as a specific requirement to enter a particular professional school, especially in the health sciences. Additional, many students are pursuing goals of personal improvement which are not degree related.

4. TYPE OF DEGREE

Associate of Science in Physical Science

With advising track: Chemistry, Physics, General Physical Science, Pre-Engineering

5. GOALS AND OBJECTIVE OF DEGREE PROGRAMS

Student successfully completing the physical science degree plan will be prepared to enter a four-year program at the junior level, and will be able to do successful work at their transfer institution.

Student will be expected to acquire a working knowledge of many of the applicable physical laws and also develop the analytical skills required of students in the various professional programs.

Specific objectives include:

- introduction to the “language of science”, and development of communication skills, including the reporting of experimental results
- development of an understanding of the “scientific method”
- development of critical thinking skills including analysis and synthesis
- development of skills in utilizing auxiliary resources

- development of an appreciation for the use of the scientific theories and modeling methods, including the original development, testing, modification, and use in explaining observed phenomena
- development of a sense of the impact of science on society within its cultural and historical perspectives
- development of laboratory skills, including experimental design, laboratory safety, data acquisition, data analysis, evaluating significance, and the proper reporting of results
- development of collateral mathematical skills, at the calculus level or beyond
- development of the personal skills for success, such as self-motivation, discipline, time management, use of resources, and personal communications
- promotion of science as a cooperative, accumulative process
- utilization of the computer to aid in data acquisition, analysis, and report preparation, and as a tool in researching data banks
- providing a solid foundation for advanced courses at the upper division

Collateral outcomes which are desired, but for which direct methods of assessment of outcomes are not available include:

- ❖ preparing pre-professional students for the physical sciences portion of the admission examinations required of applicants to the respective professional schools
- ❖ introduction to the underlying unity and complementary of the physical universe through the study of several separate, but related, topics
- ❖ introduction to many of the various mathematical models of the physical universe, and the use of mathematical models and problem solving in real life situation and the laboratory
- ❖ providing direct laboratory experience in measurement and experimentation relating to the subject matter discussed in the lecture session
- ❖ providing a sense of the history of the development of science, especially the physical science

The graduate of the physical science degree program will have achieved most of the program objectives listed above. Specifically, he or she will be able to enter upper division courses in the major field of study without any deficiencies in the prerequisite courses.

6. FACULTY AND QUALIFICATIONS

- Dr. M Nealon, Ph. D, University of Oklahoma – Physical Science Department Chairman
- Dr. Krishna Bastola , Ph. D., Oklahoma State University – Chemistry Department Chairman

7. DEMAND FOR THE PROGRAM

A. Demand from students: Any student planning to enter a baccalaureate program in astronomy, geology, meteorology, or physics will probably enroll in the physical science program. In addition, since the closure of the engineering program here at EOSC, the only viable alternative for the student planning to enter a baccalaureate engineering program is to enroll in the physical science program.

B. Demand for students produced by the program: At the present time, students graduating from baccalaureate physics degree program are in such demand nationally that graduate programs in physics have had a significant drop in enrollment. The salaries offered these graduates are in excess of $50,000 for an average student, to six-figure salaries for the top graduates. Chemistry graduates are in demands as well, but the differential in earning for advanced degrees has not produced as significant a drop in graduate enrollments. This is true for the graduates of smaller colleges, as well as the major institutions. Similar situations hold for other physical science graduates, although the salaries may not be as lucrative. In some areas of the physical sciences, such as astronomy, the advanced degree is the entry level.

C. Demand by students for services provided by the program: Students are supported by a number of available services, including computers in the physics labs available for use in data analysis, report writing, and tutorials. Students are also able to obtain assistance for any of their studies or lab work from instructors who are available many additional hours outside of class, labs, and regular office hours.

D. Indirect demands: Services provided to the community at large occur primarily as a result of requests from teachers, area high school students, and general public. This may include anything from setting up telescopes for eclipse viewing, perhaps supplying information on general interest topics, to help in solving more technical problems when asked. Additionally, the staff of the Physical Sciences Department is accessible to area high school students and teachers as consultants for school science fair judges. The Eastern Oklahoma Regional Science & Engineering Fair is hosted on the Eastern campus and directed by Mr. Juarez for the benefit of the students further afield than Southeastern Oklahoma. The other members of the entire Science Division help in various ways in these and other service to the community.

8. RESOURCES REQUIRED FOR THE PROGRAM

A. Financial support: The operational expenses of the physical science program are provided by the Physical Science Department budget. Purchase of equipment and supplies, photocopying, travel, telephone toll charge, and the maintenance of equipment is also allocated to this budget. The budget has decreased significantly over the last several academic years, just at the time when up-dating of equipment in the laboratories was being undertaken. A capital outlay of approximately $16,000 was allowed for purchase of computer-based physics laboratory equipment in 2000 and only maintenance funding has been available since them. The budget for chemistry is barely adequate to meet the demand of consumable supplies, and does not allow for replacement of out-dated equipment or the introduction of modern laboratory information management systems.

B. Library collections: The Eastern Oklahoma State College Library contains numerous books and periodicals available for student use in support of their courses. Many of these references are general in nature, reflecting the needs of the students, although some titles reflect more specialized topics within the purview of the physical sciences. In addition, many complimentary examination copies of text books have been placed on the library shelves as a resource for the student.

C. Facilities: The equipment used in the physical sciences program includes much of the equipment traditionally used in introductory physics and chemistry courses. Much of the equipment is old and being replaced as funding is available. The use of computers in the physics laboratory is now reality,

but the same opportunities have not been afforded to physical science and chemistry students due to limited funding. The computers in use are all hand-me-downs from other laboratories on campus. The use of computers in data analysis and preparation of repots has been in place for several years, but computer-based laboratory exercises have only been available since the 2000-2001 academic year. Additional computers and interfaced laboratory equipment are needed to enable students to gain the experience needed to make a smooth transition into a four-year program, particularly in the second semester courses in physics and in chemistry labs. Much of the remaining equipment proposed for purchase in physics and chemistry will be applicable in other physical sciences courses. A primary concern is the fact that the physics laboratory is currently used as a classroom for other than physical sciences. This has resulted in the usage of equipment and facilities which creates an additional expense for the department and the college. This situation has been exacerbated as computer hardware and interfaced experimental equipment has been more fully utilized.

D. Support Service: Support for the academic program at Eastern consist of the normal support staff of any institution, including custodial staff, Physical Plant personnel, Food Service, Financial Aids office, Business Office, Student Affairs office, High School Relation office, Academic Affairs office, and the President's office. Additionally, students are supported by a number of available services, including computer labs available for use in data analysis, report writing, and tutorial aids. Student Support Service tries to provide student tutors covering basic courses; however no tutor is available for chemistry, physics, and upper level mathematics on a regular basis. Students are also able to obtain assistance in any of their studies or lab work from instructors who are available many extra hours outside of class and labs.

E. Use of technology in instructional design and delivery; at the present time, the primary usage of technology has been in the use of computer analysis of data, and in the use of graphing calculators on the classroom. The use of smart boards has been incorporated into the classrooms/labs.

9. PROGRAM UNIQUENESS

There are few programs available to the students which incorporate the wide range of exposure to the various sciences and mathematics courses that the physical sciences program does. It is the primary background program for many of the upper level professional physical science programs, including astronomy, chemistry, geology, meteorology, and physics. It serves as a significant component of the science requirement for secondary education students seeking the science endorsement. The development of abstract reasoning skills, together with the acquisition of background knowledge, is the reason physical science courses are required in most pre-professional physical and health science programs. Additionally, the student has an opportunity to further develop and utilize the mathematical skills that he or she will need throughout his or her professional career.

The physical science program attempts to prepare each student for success at the later stages of their professional development, regardless of the ultimate goal and entry level skills. The development of an analytical approach to problem solving is strongly promoted. We believe that this skill is necessary for the student to be successful in subsequent courses.

10. INSTRUCTIONAL COST

The estimated cost of instruction of the Physical Science is listed in the Oklahoma State Regents for Higher Education "Standard Field of Study Cost" report.

11. FACULTY/STUDENT RATIO

Faculty/Student Ratio: The faculty/student ratio in the physical science program is approximately 1/22.

12. NUMBER OF MAJORS

The number of individuals who are listed as majors in one of the physical sciences and advised by faculty in the program is significantly greater than the number of graduates. There are typically fewer than ten full time students who enroll as physical science (including chemistry and physics) majors, but many of them take the science and mathematics courses and do not finish the degree. Most of them enroll in fifteen to eighteen hours of credit courses per semester. Some students who have acquired concurrent enrollment credits while still in high school have only spent one academic year in the program before transferring to a senior institution. Students wishing to enter an engineering or other professional program at the transfer institution may need to transfer as soon as possible to avoid delaying upper level course work which has prerequisites that must be met before entering the professional program.

The physical science program is expected to remain a low-enrollment program. It is offered as background preparation for the student who wishes to do upper division work in astronomy, chemistry, engineering, geology, meteorology, physics, or mathematics. All courses offered in the program have enrollment from other areas such as pre-professional programs in engineering, agriculture, or allied health fields, and the majority of the enrollments are from these areas. There are also a few secondary education majors working toward their science certification, and these students will also enroll in some of the physical sciences courses. Occasionally, current high school teachers enroll in some of the courses to upgrade their skills, and/or their certification. Concurrent high school students also enroll in classes offered by the Physical Science Department.

The trend in student enrollments is not expected to change significantly in the near future. While the employment outlook for new baccalaureate physical sciences graduates is good, the mathematical and science requirements in the degree program are a deterrent to many students who are inadequately prepared and/or motivated. Graduate degree programs in physics are down in enrollment due to a combination of factors. Other graduate programs are suffering similar decreases. High starting salaries for some baccalaureate graduates, as shift in national priorities away from pure science, and reduced funding for scientific research leads to fewer students interested in graduate degrees in sciences. The training period for new research scientist is approximately the same as for a physician. Ironically, as many scientist approach retirement, the demand for new scientist to replace them is greater, but the domestic supply is decreasing, and more of these positions will be filled by graduate students coming into the US from foreign country.

13. SIZE OF SPECIALIZED CLASSES

Enrollment in the specialized courses in the physical sciences is included below. Mathematics supporting courses are addressed in the self-study of the discipline. Students in physical sciences will typically take 8 hours of physics, 10 hours of chemistry, and at least 4 hours of additional physical science courses. The students will be advised to take mathematics through integral calculus or differential equations, depending on the individual student's entry level math skills, and upper level degree objectives.

The following table shows the enrollment in the specialized physical science courses which were offered during the last three years. The numbers of majors has not shown a significant increase.

	2015-2016	2016-2017	2017-2018
Chemistry 1315 (General Chemistry I)	63	95	91
Chemistry 1415 (General Chemistry II)	21	13	22
Chemistry 2105 (Organic Chemistry I)	2	4	3
Chemistry 2205 (Organic Chemistry II)	1	2	-
Physical Science 1124 (Astronomy)	79	44	45
Physical Science 1214 (Earth Science)	38	36	53
Physics 1114 (general Physics I)	13	16	18
Physics 1214 (General Physics II)	4	6	3
Physics 2014 (Engineering Physics I)	4	7	4
Physics 2114 (Engineering Physics II)	3	4	3

14. NUMBER OF FULL-TIME EQUIVALENT FACULTY

The full-time equivalent faculty in physical science consists of Dr. M Nealon, Department Chair, who teaches full time in the Physics and Physical sciences and Dr. Krishna Bastola, who teaches full-time in the Chemistry Department.

15. SUCCESS OF TRANFERS STUDENTS

Generally, the success of transfer students is determined by the motivation of the student. While there are only seven (7) graduates of the program during the previous five years, there has been no information received from transfer institution to allow direct follow-up studies of student performance.

Informal reporting from individuals or from family members of this program's graduates indicates generally that students progress normally toward their objective, or have obtained baccalaureate degrees.

16. METHODS AND PROCEDURE FOR MEASURING PROGRAM OBJECTIVE AND OUTCOMES

The procedures for evaluating the progress of the program include:

- continual monitoring of laboratory and classroom equipment,
- monitoring professional development of the instructional staff,
- monitoring the utilization of computer technology in classroom and laboratories,
- monitoring the success of students after transfer to an upper-level program,
- periodic examination of the progress of students in the various courses,
- weekly review of the homework and laboratory work assignments of the students,
- personal interviews with students near the completion of their program, and

- ❖ periodic reviews of course content, delivery methods, and effectiveness.

17. METHODS AND FREQUENCY OF CURRICULUM REVIEW AND EVALUATION

The curriculum content is continually reviewed by the instructors. This evaluation includes comparison of course content and textbooks with other instructors in the state at various professional meetings, and by reviewing the newer texts available in the course. The program content is reviewed by evaluating what is expected of the student at the various transfer institutions. Additionally, an informal discussion with past students is used to gauge the effectiveness of the individual course in preparing the students for what she or he encounters at the transfer institution.

18. UTILIZATION OF PAST ASSESSMENT DATA AND INFORMATION FOR PROGRAM IMPROVEMENT

The last major review of this program in 2000 indicated that more state-of-the-art equipment, including computer hardware and software and computer-interfaced experiments would improve the program. While program has been made in this direction, limited budgets have resulted in less progress than desired. This continues to be a concern, because of the continuing shift toward computer-based measurement in all scientific arenas. At this time, the gap between the laboratory environment and the current state-of-the-art has been decreased, but it is not closed. It is realized that it will not be possible to purchase some available equipment because the cost is prohibitive for the limited number of experiments which can be performed in the available laboratory time in the courses offered. A concerted effort to maintain progress toward a fully integrated computer-based laboratory will need to be maintained. High-tech multimedia usage, computer simulation software, and increased usage of computers for laboratory analysis is similarly affected by limited budget, although some progress is being made in these areas as well.

19. NUMBER OF GRADUATES

Year	Number of Graduates
2014	1
2015	2
2016	1
2017	2
2018	1

20. NUMBER OF CREDIT HOURS

Heading (see attachment A for details)	Number of credit hours
Program	64
General Education	40
Major Field	20
Supporting/Electives	4

21. INSTITUTIONAL PROGRAM RECOMMENDATIONS

A. Recommendations as a result of the review: The program strength is in meeting the needs of the student, congruent with the institutional mission. The student is well prepared to enter studies in a professional program at the transfer institution without any deficiencies. Contact with instructors is encouraged, and tutoring is frequently done by the instructor, when necessary. The availability of instructors for many additional hours outside of scheduled class and laboratory periods is also a strength of the program. It is recommended that this student contact be maintained.

The primary weakness of the program is the small number of majors. This is not uncommon in a program such as ours, and is observed on a national scale as well. The entry level of preparation required of majors in this program is deterrent to many students, as is the level of the curriculum in the major courses and the associated mathematics courses. Few students seem willing to attempt such a rigorous program, or remain in such a challenging program if they do start. Better information delivered to high school counselors should help in preparing the student for entry into the program without background deficiencies, and should also help the student avoid the shock of finding such a rigorous course load.

The program will be improved by the inclusion of more state-of-the-art equipment, including more computer hardware and software and computer-interfaced experiments. An increased usage of high-tech multi-media in the classroom and in learning laboratories should enhance student understanding and interest, when such resources are available. It is recommended that additional funds be allocated for use by the Physical science Department to continue the improvements in hardware and software suitable for use in the Physical Science laboratory settings. If the department budgets were to be increased or capital funds allocated, additional progress could be made. It is estimated that an additional $50,000 to $60,000 would be needed to upgrade laboratory equipment and an additional $8,000 - $10,000 for computer hardware, interfacing, and software. In the chemistry laboratory, spectrophotometers, centrifuges, some precision balances, and pH meter need to be replaced to keep pace with area high schools. In the Physical science laboratories need to be furnished with up-to-date equipment.

The recommendation of the study committee is the continuation of this program, with the recognition that it will not likely become a large enrollment program.

B. Anticipated changes in this program: Priorities for the physical sciences program are for the upgrade of the laboratories and learning environment. An increased access to multi-media resources and computer simulation software is a major component of this planned upgrade. A collateral improvement in the usage of computers in the mathematics program should further enhance the success of physical sciences students.

22. ADDITIONAL BUDGET REQUESTS TO ACCOMPLISH GOALS AND OBJECTIVES

As indicated in the text of the study above, it is estimated that an additional $50,000 - $60,000 is required to bring the physical science, physics and chemistry laboratories up to current needs. In addition it is

estimated that $8,000 - $10,000 would be required to provide the computer hardware and software. This request assumes two students per station in the laboratory, and would require either limited numbers in a laboratory session or a rotation of student groups between computer-assisted laboratory experiments and the more traditional desk-top laboratory experiments. The total of these requests, $58,000 - $70,000, would be a minimum expenditure to upgrade to state-of-the-art laboratories.