

COURSE PROPOSAL FOR PHS 199

SCIENTIFIC RESEARCH METHODS

General Information

Meeting Time: Daily 8:00 AM to 8:00 PM
Duration: June 5 through July 9 AND Aug.27 - 29, Sept.24 - 26, Oct. 8 - 10, 1999
Credit Hours: 3 Credit Hours
Instructor: Terry Hubbard
Office Hours: The Four-Corners Program staff will offer office hours by appointment.

Course Pre-requisites

The course is funded by the U.S. Department of Education and students must be high ability high school students who have been chosen on the basis of a detailed application. For admittance to the course, students must have successfully completed at least one semester of Algebra I and one high school science class, maintained a high grade point average in all high school courses, and be highly recommended by two teachers. Students must also meet federal TRIO guidelines for low-income and/or be potentially from the first generation in their family to earn a four-year college degree. Students applications are reviewed by program staff, including the Project Director, Program Coordinator and both the Science and Math Core Faculty members.

Course Description

The proposed course was designed to mimic the process of undergraduate research and provide rising 10th, 11th, and 12th grade students with an interdisciplinary research experience. Course design and materials were tested during the summer of 1991 Summer of Science programs supported by the National Science Foundation and 1993 - 1998 Four-Corners Program funded by the U.S. Department of Education.

The course has four phases of activities, each phase building on the content and training of the previous phases.

Phase I -- Course Work Emphasizing Interdisciplinary Approaches to Research in Science and Mathematics

Phase II -- Learning Research Methods Under the Guidance of a Research Advisor.

Phase III -- Data Analysis and Presentation of a Scientific Paper Describing the Completed Research

Phase IV -- Weekends of Science, Study Skills, Career and Financial Aid Counseling

Phase I will be completed in a two-week session that includes a range of lectures, seminars, research experiences, training in research methods interspersed with study skills workshops. During the next two-week session (Phase II), students assist scientists conduct their research by investigating a question that is a small part of the professional's larger project. Phase III is a one-week session devoted to data analysis, the writing of a scientific paper, and the presentation of

the research and paper at a scientific conference held at Northern Arizona University (NAU). The final phase of the program (Phase IV), consists of three weekends at NAU between July 13, and October, 31, 1999. During this final phase students are provided: 1) comprehensive assistance in the application process for colleges and universities including financial aid 2) additional study skills instruction and 3) exposure to careers by attending a Career Fair, Science Lectures and the Flagstaff Festival of Science 4) students are also introduced to the history, philosophy, and ethics of scientific research.

Reading Materials

Course materials include a broad range of readings from the original scientific literature as well as a number of college level science and mathematics textbooks. A complete bibliography is available upon request. All materials are provided to the students by the Four-Corners Program.

Course Objectives

1. Introduce students to interdisciplinary research.
2. Provide training in the ancillary skills needed to "do" Science (1) technical writing; (2) reading complex literature; (3) basic mathematics principals (4) experimental design and statistics; (5) acquisition of information in libraries and computer data bases.
3. Develop an understanding of science in a societal context by exploring issues in the history, philosophy, and ethics of research.
4. Provide students with a research internship in one of six discipline areas: (1) biology, (2) chemistry, (3) forestry, (4) geology, (5) physics/astronomy, or (6) applied sciences
5. Provide students with the skills, and network of professionals, necessary for college/university entrance.

Evaluation Methods

Students will be evaluated by six methods:

1. Use of pre- and post- test assessments of knowledge about science content, mathematics proficiency, including ACT or PLAN exams, depending upon grade level.
2. Use of student portfolios to assess general quality and overall improvement in writing, analytical, and problem-solving skills.
3. At least one quiz to assess knowledge of each individual
4. Faculty evaluation of student participation and quality of contributions in classroom discussions and research internships
5. Evaluation of scientific paper written by students after completion of their independent research project.
6. Evaluation of presentation of research at a scientific conference

This is a graded course. Students must participate in all four phases of the program. If a student does not satisfactorily complete all phases of the program the student will fail the course and earn a grade of an F.

Topics Covered During Course

1. Experimental Design and Statistics

2. Interdisciplinary Research: An Analysis of Methods of Studying and Publishing Scientific and Mathematics Literature
3. Science-Technology-Society: An Analysis of the History, Philosophy, and Ethics of Science in Societal and Technological contexts.
4. Research Methods in:
 - a. Biology
 - b. Chemistry
 - c. Engineering
 - d. Mathematics
 - e. Physics/Astronomy
 - f. Applied Sciences
5. Post-Secondary School Application Process
 - a. comprehensive assistance in the application process
 - b. comprehensive assistance in the identification and application for financial aid