

## **COURSE PROPOSAL FOR PHS 199**

### **SCIENTIFIC RESEARCH METHODS**

#### **General Information**

Meeting Time: Daily 8:00 AM to 9:00 PM  
Duration: **On NAU Campus:** June 8 through July 17, 2002  
Credit Hours: 3 Credit Hours  
Instructor: Terry Hubbard  
Office Hours: The Four Corners Program staff will offer office hours by appointment.

#### **Course Pre-requisites**

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. They must demonstrate a need for the program by meeting federal TRIO low-income guidelines and/or be potentially from the first generation in their family to earn a four-year college degree. They must indicate a desire to improve their high school GPA and test scores. The Project Director and Program Coordinator both review student's applications. The U.S. Department of Education funds the staff's salaries.

#### **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 NAU - Summer of Science program supported by the National Science Foundation and the 1993 - 2001 Four Corners Upward Bound Math and Science Program funded by the U.S. Department of Education.

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

**Phase I** -- Coursework Emphasizing Interdisciplinary Approaches to Research in Science and developing familiarity with the university library, and career exploration.

**Phase II** -- Applying Research Methods learned in phase I to a four-week research project under the guidance of a Research Advisor. All students will present the results of their research at the annual conference. Supplementary daily core courses in math, reading, English, and science will be tailored to each student's individual needs. To facilitate the transition from high school to college, students will meet regularly with an academic advisor to assist them with formulation of their career goals, to plan their course of study throughout high school, and to apply to college and financial aid. Language (Navajo and Spanish) will be taken on Wednesday evenings.

**Phase III** – As an incentive for students to participate in the program at least two summers, the rising 12th grade students will participate in a sixth week of activities including visits to college and university campuses, career exploration at parks managed by government agencies, and tours of businesses that hire engineers, scientists and mathematicians.

**Phase I** will be completed in a one-week session. Students will research the cost to live in different communities and formally present the results. They will use this to explore career options that would fit their personalities. Prior to any formal instruction students will have their skills measured in the areas of science reasoning, math, English, and reading using the ACT standardized college entrance exam. Supplementary core courses and academic advisement will begin immediately.

During the next four-week session (**Phase II**), students will conduct science research each morning and attend supplementary core classes each afternoon. Each morning, students will conduct their research by investigating a question that is a small part of a graduate student's larger project. The graduate student will be the students' instructor. Each afternoon students will attend small classes in reading, math, English, and Spanish to improve their foundation skills in these areas. The high school students will also be required to meet with their Academic Advisor once a week during a scheduled meeting. The ACT exam and science conference presentations and research papers will be used to assess any benefit from instruction. **Phase III** Rising seniors will participate in a week long trip, visiting, science museums, businesses, research facilities etc, that employ engineers, scientists, and mathematicians.

### **Reading Materials**

Course materials include a broad range of readings from the original scientific literature as well as resources developed by the instructors. A complete bibliography is available upon request. The Four Corners Program provides all materials to the students.

### **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 databases.
3. Provide students with the basic foundation in core courses including English, reading, math, science reasoning, and foreign language. Advise students to enroll in college bound and advanced placement classes in their high schools.
4. To develop effective time saving study techniques in each subject by improving students abilities to communicate with current and future instructors on exams, preparing for exams, and one-on-one career preparation assistance.
5. Familiarize students with research experiences in areas: such as engineering, laboratory or field biology, chemistry, physics or applied sciences and science related fields.
6. Provide students with the skills, and network of professionals, necessary for college/university entrance.

## **Evaluation Methods**

Students will be evaluated by at least eight methods:

1. Use of pre- and post- test assessments of reading, math, English, and science reasoning skills, and foreign language skills in Spanish and Navajo.
2. Use of student portfolios to select colleges, meet college entrance requirements, apply to colleges, and apply for financial aid.
3. Quizzes to ensure students remain abreast of the material. To become familiar with being “quizzed” frequently which will reduce students’ anxiety of taking quizzes because they will learn how to anticipate and prepare for them in each subject area.
4. Instructor evaluation of students’ participation in classroom discussions and research internships, including the quality of their contributions.
5. Evaluation of scientific paper, and presentation.

This is a graded course. Each student’s final grade will be based on the average of grades from all subjects including career exploration paper and presentation, science, reading, math, English, and foreign language. Students who are entering their sophomore and junior years in high school must participate completely in phases I and II of the program. Students who are entering their senior year must participate in phases I, II, and III, including financial aid preparation on alternate Monday evenings. If a student does not satisfactorily complete all required 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
6. Basic skill development in reading, English, math, foreign language.
7. Post-Secondary School Application Process
  - a. Comprehensive assistance in the application process
  - b. Comprehensive assistance in the identification and application for financial aid