Undergraduate Research Program in Chemistry at Philander Smith College

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3. Melosira Numuloides and Grammataphora have also been observed to rotate the plane of polarization of visible light.

4. Some specimens of Triceratium favus, Nitzschia sp. and Coscinodiscus sp. from Pensacola, Florida, and St. Andrews Bay, Florida, have also exhibited optical activity. The reasons why these diatoms affect the plane of polarization of visible light is not yet thoroughly understood.

V. COMPLEMENTARY COLOR PHENOMENA IN ACTINOCYCLUS

An interesting effect has also been observed in diatoms of the Genus Actinocyclus. An unusual diatom, which appeared green in bright field illumination, was first observed in a spray of diatoms from Apalachicola, Florida. This diatom, Actinocyclus Ehrenbergii, changed to brilliant red as the microscope condenser was moved from dark field illumination. Several other diatoms of this species from Pensacola, Florida, also exhibited the same property. The diatom, Actinocyclus ellipticus, from Richmond, Virginia, was found to have the same ability to switch from one color distribution to the complementary


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An Undergraduate Research Program In Chemistry At Philander Smith College

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Introduction

Philander Smith College is a predominantly Negro institution located in the heart of Little Rock, Arkansas. It is supported by the United Methodist Church. The school has an enrollment of approximately 750 students and is accredited by the North Central Association of Colleges and Secondary Schools. Baccalaureate degrees are granted in arts and sciences and teacher education.

Philander Smith College maintains an integrated faculty and strives to serve the undereducated and the underprivileged student. The college offers special opportunities and support for students who:

(1) Need assistance in the development of college level skills in reading, writing, listening, organizing, and interpreting information and mathematics;

(2) Show evidence of ability to achieve academically in a small, individually oriented college curriculum.

The Chemistry Department is part of the Division of Natural Sciences. The chemistry faculty consists of a full-time Ph.D., two part-time M.S. level instructors and a part-time Ph.D. At times, other part time people are used to teach special topics. There are 3-6 junior and senior chemistry majors at any time with 10-20 junior and senior minors.

The chemistry program has been developed in the

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past three years with a stable part time and full time faculty. In this period the course work has approached the American Chemical Society requirements, and undergraduate research has been instituted.

Facilities

Undergraduate research in chemistry at Philander Smith College appears to be impossible when one considers the laboratory and library facilities on campus. The library on campus is excellent for a liberal arts college, but it does not have the collection of scientific books and journals that are required for research. The laboratories are not adequately equipped for current teaching purposes.

Fortunately, in Little Rock there are two good scientific libraries. These are at the University of Arkansas Medical Center (UAMC) and at the Graduate Institute of Technology (GIT), University of Arkansas. Most current journals in chemistry are received by these libraries, and all major journals are on hand for several years back. The various standard reference handbooks are available as well as several hundred volumes on chemistry topics. Both institutions have complete sets of Chemical Abstracts.

There are also some very good research laboratories in Little Rock at the branches of the University of Arkansas and the Veterans Administration Hospital.

Since the author is an employee at the Veterans Administration Hospital and has appointments at UAMC and GIT, it was decided that an undergraduate research program in chemistry could be established at Philander Smith College.

In the physical chemistry laboratory at the VA hospital, the following major equipment is available: light scattering photometer, differential refractometer, UV-Vis spectrophotometer, and electron spin resonance spectrometer. Many other types of minor equipment are also available. The VA hospital administration was more than willing to cooperate on an education project of this type as long as the students were supervised by VA personnel.

Program

In the fall of 1966, this undergraduate research was started with one student. This was not a formal program, and the student could not obtain credit for the work because it was not listed in the catalog. However, the student did spend ten or more hours working in the laboratory each week on a research project.

Initially, the student worked with an M.S. chemist to learn techniques. A project was chosen by the student from several suggested by the author, and the student began reading while she was learning lab procedures. After approximately one month, the student started performing work on her own project.

During the course of the year, she read and discussed the project with the author. She developed a better understanding of chemistry and a greater interest in school as a whole. Because of this work and interaction, she decided to go on to graduate school. It was the success with this student that initiated the expansion of the program.

In the past two years, arrangements have been made to allow students to obtain up to four hours credit for research. The course has been made more formal and serves as a real supplement to the program for chemistry majors.

The current program includes lectures and reading about research techniques in addition to working on a research project. The book, "Introduction to Scientific Research", by E. Bright Wilson, Jr., is used as a text. The material in the book as well as laboratory techniques are discussed in lectures. These lectures are really seminars that are held at least every two weeks. At the end of the year, the students present their work in these seminars.

The research work is done in two 3-4 hour sessions per week. Generally two students are working in the laboratory at a time, and the author will spend some time in each session with them individually. In these individual discussions, the students learn how to interpret data and project further experiments.

The projects are chosen in such a manner that they can be finished in an academic year. The student then writes his work up in a format for publication and presentation. This phase is an important teaching part of the program and is an aspect that is not available in any other part of their college work.

Goals

The chemical research program at Philander Smith College has several goals which are especially worthwhile for the students at an institution of this type. The principle goals are to create interest in chemistry on the part of the students, to fill in some of their weaknesses and to better prepare the students for industry or graduate school. All of these goals are met with an increased interaction between student and teacher in a research training situation. A research problem becomes a teaching tool in much the same way it is in graduate school.

The student develops a greater interest in chemistry as a career while doing a research problem because this is a real situation with a purpose and not just another laboratory experiment. The feel of doing something that has not been done adds enthusiasm. Of course some students discover that chemistry is really not what they wanted, which is also worthwhile.

The laboratory work develops a better understanding concerning why careful measurements are important. The students learn to be careful with expensive equipment,
because their work depends on the use of the equipment. The measurements are made more carefully when they see how carelessness can cause scatter in data so that it cannot be interpreted. The research project is different from a laboratory experiment because the answers are not known. Again, the challenge of doing something new is important.

The student also learns to keep good records and to make them permanent so someone else can follow them. This is developed as they try to repeat other work while checking techniques and also as they need to look up something they did in the past. This aspect is discussed initially and monitored periodically. The best teaching tool here is when the student makes mistakes and has to work to find some information he has previously taken.

Throughout the program, the student is encouraged to ask questions about the work and make decisions on what to do next. This process means that a lot of mistakes are made and time is wasted, but the students learn by their mistakes. The project is the student’s responsibility as much as possible; but of course, they receive a lot of guidance.

A major goal of this research course is to teach the student to present his results both orally and in writing. The student tabulates and graphs his data and discusses it with the author before he starts writing. After this data interpretation session and some general guides on writing the work up, the student writes up the research work. The format is generally according to American Chemical Society journals.

The paper is then criticized by the author before the student presents his work in a seminar. The student then presents his work to the other students and chemistry faculty in a seminar. Here he answers questions and defends his results.

After the seminar, the student writes a final paper and receives a grade for the course. If the project is sufficient in scope, it is submitted for publication. Frequently, two or three projects are put together for a journal article.

Results

Six students have worked on research projects during a three year period. Five of these students are currently working on projects, and three of these will work in the program next year. These projects and the students are discussed in this section.

The first student in 1966-67 worked on a determination of hydrolytic species of UO$_2^{++}$ using the coagulation of silver halides as a tool. The coagulation was followed with a light scattering photometer. Precise solution preparation and pH measurements were required. This student finished the project and prepared it for presentation. The work was presented at a regional meeting of the American Chemical Society (ACS) and has been submitted for publication. The student went on to graduate school at Wayne State University in Detroit.

In 1967-68 a second student (a junior) started working on a light scattering project. This project was to see if the technique used to study hydrolysis could be extended to general complex studies. This project developed many problems and has been finished this academic year. The work is very good and will be presented at an ACS meeting and submitted for publication. The student has developed into an excellent laboratory worker and plans to work for the Defense Department as a chemist and attend graduate school part time.

In the fall of 1968 three additional students, one senior and two juniors, entered the program. This was when discussions and more formal sessions were developed. At semester, another junior student started a project. These projects are as follows:

1. Mn$^{++}$ -Cl$^{-}$ complex formation in dimethyl formamide. This is a spectrophotometric study using the mole-ratio method to confirm some ESR studies. This project was completed at semester and is being written up. It will be incorporated into the ESR paper or published as a note.

2. Solvent effects of Mn(C10H6)$Cl_2$ in dimethyl formamide - methanol. This is an ESR study that appears to be a promising piece of work. It will be carried over to next year.

3. Effect of solvent on the coagulation of AgI in n-propyl alcohol-water mixtures. Th$^{++}$ is used as a tool to measure this effect by light scattering techniques. This work is almost complete and will be written up this semester. This student is a senior and is going on to graduate school.

4. Complexes of Mn$^{++}$ with portions of an ATP molecule. Two projects have been started in this area. Ribose and PO$_4^{3-}$ are being used in these two studies. ESR is the tool that is used for studying possible complexes.

In general the program is creating interest among students. At the same time it is developing students who have potential by giving them self-confidence as well as additional training. A cooperative arrangement of this type would be useful for many small colleges that do not have equipment for good research projects.