

**INFORMATION ABOUT PRINCIPAL INVESTIGATORS/PROJECT DIRECTORS(PI/PD) and  
co-PRINCIPAL INVESTIGATORS/co-PROJECT DIRECTORS**

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Submit only ONE copy of this form for each PI/PD and co-PI/PD identified on the proposal. The form(s) should be attached to the original proposal as specified in GPG Section II.B. Submission of this information is voluntary and is not a precondition of award. This information will not be disclosed to external peer reviewers. **DO NOT INCLUDE THIS FORM WITH ANY OF THE OTHER COPIES OF YOUR PROPOSAL AS THIS MAY COMPROMISE THE CONFIDENTIALITY OF THE INFORMATION.**

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**PI/PD Name:** Eugene J Billiot

**Gender:**  Male  Female

**Ethnicity:** (Choose one response)  Hispanic or Latino  Not Hispanic or Latino

**Race:**  American Indian or Alaska Native  
(Select one or more)  Asian

Black or African American

Native Hawaiian or Other Pacific Islander

White

**Disability Status:**  Hearing Impairment  
(Select one or more)

Visual Impairment

Mobility/Orthopedic Impairment

Other

None

**Citizenship:** (Choose one)  U.S. Citizen  Permanent Resident  Other non-U.S. Citizen

**Check here if you do not wish to provide any or all of the above information (excluding PI/PD name):**

**Pecase Eligibility:** Y

**REQUIRED: Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project**

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**Ethnicity Definition:**

**Hispanic or Latino.** A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race.

**Race Definitions:**

**American Indian or Alaska Native.** A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.

**Asian.** A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.

**Black or African American.** A person having origins in any of the black racial groups of Africa.

**Native Hawaiian or Other Pacific Islander.** A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.

**White.** A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

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**WHY THIS INFORMATION IS BEING REQUESTED:**

The Federal Government has a continuing commitment to monitor the operation of its review and award processes to identify and address any inequities based on gender, race, ethnicity, or disability of its proposed PIs/PDs. To gather information needed for this important task, the proposer should submit a single copy of this form for each identified PI/PD with each proposal. Submission of the requested information is voluntary and will not affect the organization's eligibility for an award. However, information not submitted will seriously undermine the statistical validity, and therefore the usefulness, of information received from others. Any individual not wishing to submit some or all the information should check the box provided for this purpose. (The exceptions are the PI/PD name and the information about prior Federal support, the last question above.)

Collection of this information is authorized by the NSF Act of 1950, as amended, 42 U.S.C. 1861, et seq. Demographic data allows NSF to gauge whether our programs and other opportunities in science and technology are fairly reaching and benefiting everyone regardless of demographic category; to ensure that those in under-represented groups have the same knowledge of and access to programs and other research and educational opportunities; and to assess involvement of international investigators in work supported by NSF. The information may be disclosed to government contractors, experts, volunteers and researchers to complete assigned work; and to other government agencies in order to coordinate and assess programs. The information may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records", 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records", 63 Federal Register 268 (January 5, 1998).

## List of Suggested Reviewers or Reviewers Not To Include (optional)

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### **SUGGESTED REVIEWERS:**

Not Listed

### **REVIEWERS NOT TO INCLUDE:**

Not Listed

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## COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/if not in response to a program announcement/solicitation enter NSF 02-2					<b>FOR NSF USE ONLY</b>	
<b>NSF 02-111</b>			<b>07/25/02</b>		<b>NSF PROPOSAL NUMBER</b>	
FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)					<b>0239790</b>	
<b>CHE - Analytical and Surface Chemistry: Analytical Separations and Measurements</b>						
DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION	
				<b>095100152</b>		
EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)		SHOW PREVIOUS AWARD NO. IF THIS IS <input type="checkbox"/> A RENEWAL <input type="checkbox"/> AN ACCOMPLISHMENT-BASED RENEWAL		IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> IF YES, LIST ACRONYM(S)		
<b>741760663</b>						
NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE			ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE			
<b>Texas A&amp;M University Corpus Christi</b>			<b>Texas A&amp;M University Corpus Christi</b>			
AWARDEE ORGANIZATION CODE (IF KNOWN)			<b>6300 Ocean Drive</b>			
<b>5300004653</b>			<b>Corpus Christi, TX. 784125503</b>			
NAME OF PERFORMING ORGANIZATION, IF DIFFERENT FROM ABOVE			ADDRESS OF PERFORMING ORGANIZATION, IF DIFFERENT, INCLUDING 9 DIGIT ZIP CODE			
PERFORMING ORGANIZATION CODE (IF KNOWN)						
IS AWARDEE ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions) <input type="checkbox"/> FOR-PROFIT ORGANIZATION <input type="checkbox"/> SMALL BUSINESS <input type="checkbox"/> MINORITY BUSINESS <input type="checkbox"/> WOMAN-OWNED BUSINESS						
TITLE OF PROPOSED PROJECT <b>CAREER: Recruiting More Minorities Into Science Related Fields Through an Integrated Program of Research, Mentorship, Outreach, and Faculty Development</b>						
REQUESTED AMOUNT \$ <b>455,106</b>		PROPOSED DURATION (1-60 MONTHS) <b>60</b> months		REQUESTED STARTING DATE <b>06/01/03</b>		SHOW RELATED PREPROPOSAL NO., IF APPLICABLE
CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW						
<input type="checkbox"/> BEGINNING INVESTIGATOR (GPG I.A)			<input type="checkbox"/> HUMAN SUBJECTS (GPG II.C.11)			
<input type="checkbox"/> DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C)			Exemption Subsection _____ or IRB App. Date _____			
<input type="checkbox"/> PROPRIETARY & PRIVILEGED INFORMATION (GPG I.B, II.C.6)			<input type="checkbox"/> INTERNATIONAL COOPERATIVE ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.9)			
<input type="checkbox"/> HISTORIC PLACES (GPG II.C.9)						
<input type="checkbox"/> SMALL GRANT FOR EXPLOR. RESEARCH (SGER) (GPG II.C.11)						
<input type="checkbox"/> VERTEBRATE ANIMALS (GPG II.C.11) IACUC App. Date _____			<input type="checkbox"/> HIGH RESOLUTION GRAPHICS/OTHER GRAPHICS WHERE EXACT COLOR REPRESENTATION IS REQUIRED FOR PROPER INTERPRETATION (GPG I.E.1)			
PI/PD DEPARTMENT <b>Physical and Life Science</b>			PI/PD POSTAL ADDRESS <b>6300 Ocean Drive</b>			
PI/PD FAX NUMBER <b>361-825-3719</b>			<b>Corpus Christi, TX 78412</b>			
			<b>United States</b>			
NAMES (TYPED)		High Degree	Yr of Degree	Telephone Number	Electronic Mail Address	
<b>Eugene J Billiot</b>		<b>PhD</b>	<b>1998</b>	<b>361-825-2680</b>	<b>ebilliot@falcon.tamucc.edu</b>	
CO-PI/PD						
CO-PI/PD						
CO-PI/PD						
CO-PI/PD						

## CERTIFICATION PAGE

### Certification for Authorized Organizational Representative or Individual Applicant:

By signing and submitting this proposal, the individual applicant or the authorized official of the applicant institution is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding debarment and suspension, drug-free workplace, and lobbying activities (see below), as set forth in Grant Proposal Guide (GPG), NSF 02-2. Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U. S. Code, Title 18, Section 1001).

In addition, if the applicant institution employs more than fifty persons, the authorized official of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of Grant Policy Manual Section 510; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution's expenditure of any funds under the award, in accordance with the institution's conflict of interest policy. Conflicts which cannot be satisfactorily managed, reduced or eliminated must be disclosed to NSF.

### Drug Free Work Place Certification

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Drug Free Work Place Certification contained in Appendix A of the Grant Proposal Guide.

### Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency?

Yes

No

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Debarment and Suspension Certification contained in Appendix B of the Grant Proposal Guide.

### Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding \$100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding \$150,000.

### Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE		SIGNATURE	DATE
NAME <b>Sandra D Garcia</b>		<b>Electronic Signature</b>	<b>Jul 25 2002 5:25PM</b>
TELEPHONE NUMBER <b>512-994-5731</b>	ELECTRONIC MAIL ADDRESS <b>sandrag@falcon.tamucc.edu</b>		FAX NUMBER <b>512-994-2384</b>

\*SUBMISSION OF SOCIAL SECURITY NUMBERS IS VOLUNTARY AND WILL NOT AFFECT THE ORGANIZATION'S ELIGIBILITY FOR AN AWARD. HOWEVER, THEY ARE AN INTEGRAL PART OF THE INFORMATION SYSTEM AND ASSIST IN PROCESSING THE PROPOSAL. SSN SOLICITED UNDER NSF ACT OF 1950, AS AMENDED.

## CAREER ELIGIBILITY CERTIFICATIONS

### A. CAREER ELIGIBILITY CERTIFICATION

To be eligible for a CAREER award, you must meet the CAREER eligibility requirements as defined in the CAREER Program Solicitation and you must certify your eligibility by completing the CAREER checklist below. The CAREER Eligibility Certification checklist will be printed as part of the proposal and will be sent to reviewers.

**I certify that by my Directorate's July deadline for submission of CAREER proposals, I will meet all of the following criteria (verify your eligibility by checking all boxes below):**

- I will hold a doctoral degree in a field of science or engineering supported by NSF;
- I will be untenured;
- I have not previously received an NSF PECASE or CAREER award;
- I have not competed more than two times in the NSF CAREER Program;

**I certify that by October 1st following the July deadline for submission of CAREER proposals I will (check whichever box is appropriate for your type of institution):**

- be employed in a tenure-track position (or tenure-track equivalent position), as an assistant professor (or equivalent title), at an institution in the U.S., its territories, or possessions, or the Commonwealth of Puerto Rico that awards degrees in a field of science or engineering supported by NSF;

**OR**

- be employed in a tenure-track position (or tenure-track equivalent position), as an assistant professor (or equivalent title), at an institution in the U.S., its territories, or possessions, or the Commonwealth of Puerto Rico that is a non-profit, non-degree granting institution such as a museum, observatory, or research lab.

## **Project Summary**

The overall goal of this CAREER proposal is the recruitment and training of more minorities into science related fields. This will be accomplished through a program of integrated research, mentorship, outreach, and faculty development. The goal of the research portion of this proposal is an improved fundamental understanding of the chemistry involved in chromatographic separation. In particular, the research will examine the molecular recognition capabilities and potential application of media specifically designed for use as pseudostationary phases in capillary electrophoresis. The media to be studied will include a variety of novel amino acid and sugar-based anionic, cationic, and neutral polymeric surfactants. The results of this research will be applied to the development of improved separation capabilities which have the potential to have an important impact on society through the development of improved environmental methods. Additionally, since this research will be conducted primarily by undergraduate students at a minority serving institution, the research serves as an important mentoring tool for the PI. This research will provide students with a positive experience in high quality, systematic experimental design and implementation and serve as a strong incentive and basis for the student's continued success in graduate school.

There are two different components to the educational activities; 1) faculty development and 2) a component designed to increase the number of underrepresented and economically challenged students interested in pursuing careers in science. The faculty development component centers around the development of a series of seminars designed to help new faculty at the PI's home institution, Texas A&M University-Corpus Christi, become more effective teachers and researchers. The second part of the educational component will be accomplished through a program of early involvement of undergraduates in scientific research, mentorship, and outreach activities. The PI intends to recruit these underrepresented and economically challenged undergraduate students into his research group at the end of their first year. The students will then be advised to take their chemistry coursework such that the knowledge level required to properly perform their research will match and reinforce material being taught in their courses. Another aspect of the second component of the educational activities involves community outreach to the local K-12 schools. The objective of the outreach component is to interest more students in science careers and raise the awareness of these students to the environmental issues facing the local as well as the global community.

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B Table of Contents	1	_____
C Project Description (Including Results from Prior NSF Support) (not to exceed 15 pages) <b>(Exceed only if allowed by a specific program announcement/solicitation or if approved in advance by the appropriate NSF Assistant Director or designee)</b>	15	_____
D References Cited	5	_____
E Biographical Sketches (Not to exceed 2 pages each)	2	_____
F Budget (Plus up to 3 pages of budget justification)	8	_____
G Current and Pending Support	2	_____
H Facilities, Equipment and Other Resources	2	_____
I Special Information/Supplementary Documentation	2	_____
J Appendix (List below. ) <b>(Include only if allowed by a specific program announcement/ solicitation or if approved in advance by the appropriate NSF Assistant Director or designee)</b>	_____	_____
Appendix Items:		

\*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

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## **PROJECT DESCRIPTION**

### **A) RESULTS FROM PRIOR NSF SUPPORT**

The PI of this proposal is Co-PI on a Major Research Instrumentation award (Award # 0116711) that was funded September 1, 2001 entitled “*Instrumentation for the Chemical and Biological Characterization of Factors Affecting the Distribution and Phytoremediation of Seagrasses in Coastal Bays and Estuaries.*” The instrumentation requested in this proposal has been purchased and research has begun in earnest.

In addition, the PI of this proposal is also Co-PI on a recently funded Research Experiences for Undergraduates (REU) award (Award # 0139195) “*REU Site-Summer Undergraduate Research Focus: Anthropogenic Impacts on the Environment.*” We are in the middle of the first summer of funding for this project. One of the objectives of the program is to encourage more minorities and females to pursue careers in science. Of the ten students who are participating in the program this year, six are female and the rest male. Five of the six females are minorities, and all four of the males participants are minorities. We recently gave the students a mid-project evaluation form to fill out, and all the students rated the program as meeting or exceeding their expectations. Thus, in terms of student evaluations and minority participation the first year of this project has been quite successful.

### **B) CAREER DEVELOPMENT PLAN**

#### **Objectives and Significance of the Proposed Integrated Research and Educational Activities**

The main objective of the proposed integrated research and educational activities is to increase the number of underrepresented and economically challenged students interested in pursuing careers in science. This will be accomplished through a program of early involvement of undergraduates in scientific research, mentorship, outreach activities, and faculty development. The research that will be described in this proposal, is an extension of previous research by the PI. This research focuses on the synthesis, characterization and evaluation of a variety of novel monomeric and polymeric amino acid and sugar-based surfactants to be used as pseudostationary phases for the analytical separation of environmentally significant analytes using capillary electrophoresis. In particular, the research will focus on gaining insight into the factors that govern selectivity with these novel pseudostationary phases. The research activities will serve as a tool for the PI to recruit, train, and mentor students from underrepresented and economically challenged backgrounds and to encourage these students to pursue post baccalaureate degrees in science.

Texas A&M University–Corpus Christi (TAMUCC), the PI’s home institution, is an urban, comprehensive public university located on the South Texas Gulf Coast. TAMUCC has an enrollment of approximately 7,400 students, of whom 61% are female and 47% are ethnic minorities. TAMUCC is a Minority Serving Institution which has as one of its primary missions, to serve the higher educational needs of South Texas and its majority Hispanic population, which has traditionally been under-represented in institutions of higher education. According to a report published by the National Science Foundation two years ago, while Hispanics make up 12 percent of the population, they earned only 151 of the science and engineering Ph.D.s awarded in 1975 and 645 of those awarded in 1997 [1]. This represents only 4 percent of the science and engineering doctorate recipients in 1997, up from just 1 percent in 1975. Such numbers are not conducive to cultural diversity in the work force. Thus, since Hispanic students comprise 90

percent of the minority student population at TAMUCC, the recruitment efforts for the undergraduate researchers will focus on those students. Although the recruitment efforts will be focused on minorities and females, other factors such as first generation college student and economic background will be considered when assessing students as possible candidates for paid research assistants under this grant.

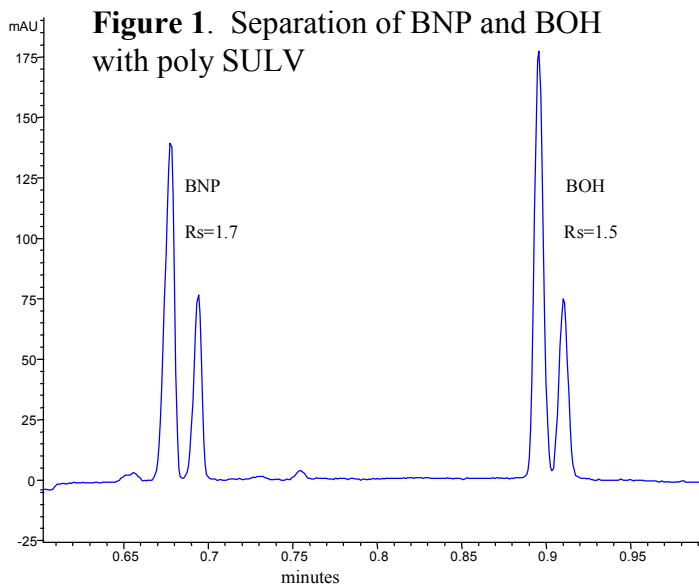
The PI's commitment to increasing the participation of underrepresented students in science can be best exemplified by discussing the types of students the PI has working in his laboratory and describing some of the other efforts the PI has made to address this problem. The PI of this proposal has been employed at TAMUCC for three years and has been conducting research for the last two years. In that two-year period, the PI has had 15 undergraduate students doing research in his laboratory, 14 of which were being supported financially to do research. Of those 15 students, 11 were minority or female. Of the four white males that have done research in the PI's laboratory, two were first generation college students. In addition, as described in the *Results From Prior NSF Support* section, the PI of this proposal is Co-PI on a recently funded NSF-REU award that has as one of its primary objectives to encourage more minorities and females to pursue careers in science. The PI's commitment to the mentoring of students coming from first generation college student/economically challenged backgrounds is recognized by the University in the fact that the PI was one of only eight faculty members who were asked to be Academic Center for Enrichment (ACE) mentors in a recently funded Title V grant. ACE participants are selected through a collaborative effort based on data from student information systems. Characteristics involved in the selection process include first generation college students, commuter and transfer students, and students eligible for Federal Pell and Supplemental Educational Opportunity Grants. These characteristics often endorse the likelihood of less support, off campus and on campus. Participants are typically from underrepresented population groups on campus.

The research component, which is intimately tied to the educational component, has the potential to have a significant impact on the lives of the student participants. The mentoring aspect of the research gives the PI the opportunity to prepare and encourage the students doing research in his laboratory to pursue advanced degrees in science. The student researchers will be exposed to a variety of analytical tools such as gas chromatography/mass spectrometry, capillary electrophoresis (CE), and a variety of spectroscopic techniques such as fluorescence, infrared, UV/Vis, and nuclear magnetic resonance spectroscopy (NMR). In addition, to developing their skills and knowledge of analytical techniques, these students will also be gaining knowledge of organic synthesis techniques. Ideally, each student will be responsible for the synthesis of at least one surfactant, or group of surfactants, which they will purify, characterize, polymerize, examine the physical properties of, and explore the potential of that surfactant as a pseudostationary phase for the analytical separation of compounds of environmental interest. The students will also be expected to examine all of the data they have collected and compare the results they have obtained with previous studies that have been performed in our laboratory and elsewhere with similar systems to gain insight into the factors governing molecular recognition leading to chromatographic separation in CE. In addition, part of the student researcher's responsibilities, as they become "senior" members of the research team, will be to train and supervise the newer members of the team. This system will help develop teamwork and will foster the development of management and supervisory skills in the "experienced" upperclassmen.

The PI intends to begin recruiting students for the research to be funded by this award as they begin their second year of college, after they have taken General Chemistry. The recruitment process will actually begin with freshman. The PI, along with other interested faculty doing research at TAMUCC will visit the general chemistry and first year biology classes to give 10 to 15 minute talks about the research opportunities available to undergraduate students at TAMUCC. The students will be told that in order to qualify for these paid positions they must be in good academic standing and show a genuine interest in the research. The students working on the project to be funded by the CAREER award will be encouraged to take Organic Chemistry and Analytical Chemistry in their Sophomore year, Advanced Instrumental Analysis and Molecular Spectroscopy in their Junior year, and the chemistry capstone course, Senior Research, in their last year. In this way, the knowledge level required to properly perform their research will match and reinforce material being taught in their courses. When they reach their senior year, they will be able to serve as very good mentors for other students taking Senior Research who have not been involved in undergraduate research as well as to the “newer” members of the research team.

The research that will be conducted as a result of funding this proposal will not only have a significant affect on the student researchers, but also on the understanding of chromatographic separations and on methodologies used for the analytical separation of environmentally significant analytes. Especially for the relatively new and growing analytical separation technique known as capillary electrophoresis (CE). The use of CE for analytical separations has many advantages over the other two commonly used chromatographic techniques: gas chromatography and liquid chromatography. Some of these advantages include lower operating costs, much higher separation efficiency, small sample size required, short analysis time, versatility, and simplicity. While the separation efficiency of high performance liquid chromatography is typically in the range of 5,000 to 20,000 theoretical plates, the separation efficiency of CE has been reported in the millions [2,3].

An example of the potential of CE to reduce analysis times is demonstrated by a report published by Richard Zare et al. In that paper, Zare et al. reported the separation of 5 of the 16 polycyclic aromatic hydrocarbons (PAHs) classified by the Environmental Protection Agency (EPA) as priority pollutants in less than 5 seconds [4]. In that same article, Zare et al., reported the baseline separation of all but two of the 16 PAHs classified by the EPA as priority pollutants in about two minutes and complete separation of all of 16 PAHs in under 10 minutes. Another example of the potential of CE is demonstrated in an article published by the PI [5]. The PI of this proposal was able to achieve baseline separation of the enantiomers of two chiral compounds [binaphthyl phosphate (BNP) and binaphthol (BOH)] in less than one minute using a polymeric amino acid-based surfactant [poly sodium undecyl leucine valinate (poly SULV)]. As can be seen in Figure 1, baseline separation of the enantiomers of BNP and BOH was



achieved in about 40 and 55 seconds, respectively. This is pretty significant owing to the fact that the enantiomeric separation of chiral compounds is one of the most challenging problems facing chromatographers today. These are just two of many studies that could be cited to demonstrate the potential of CE as an analytical technique for chromatographic separations.

### **Relationship of the Research to the Current State of Knowledge in the Field**

Capillary electrophoresis was born from the marriage of two powerful separation techniques: electrophoresis and chromatography. Electrophoresis is defined as the differential migration of charged species under the influence of an electric field. The early workers in the field of capillary electrophoresis had motivations similar to those today. They recognized that the high surface-to-volume ratio of the capillary provides excellent heat transfer, thus allowing high field strengths to be used for fast and efficient separations. They also recognized the importance of the high mass sensitivity of the technique. In 1953, Edstrom used fine silk fibers for the separation of 100 pg of RNA contained within a single cell [6]. The silk fibers were 15  $\mu\text{m}$  in diameter and about 1 to 2 cm in length. This analysis could not have been performed using the traditional separation techniques at the time because of the high mass sensitivity needed.

Several other workers made significant contributions to the development of modern CE [7-15]. However, in 1981 and in 1983 Jorgenson and Lukacs published a series of papers that generated an explosion of interest in CE [16,17]. This excitement resulted from the extraordinary separation efficiencies reported by Jorgenson and Lukacs, as well as the development of a simple and sensitive detector which was vital for the success of CE. However, since separation with CE is based on the differential migration of charged species under the influence of an electric field, neutral compounds cannot be separated using “normal” CE, capillary zone electrophoresis. Therefore, another method for the separation of neutral species had to be developed. Terabe et al. introduced micellar electrokinetic chromatography (MEKC) in 1984 for this purpose [18]. Since that time, MEKC has developed into the most widely used CE mode.

As the name implies, MEKC is a hybrid of two separation techniques, electrophoresis and chromatography. In MEKC, surfactants are added to the running buffer to act as a pseudostationary phase (chromatography). The surfactants form micelles above the critical micelle concentration (CMC), and the separation of the neutral species is based solely on the differential interaction with the micelles. For example, anionic surfactants move against the electroosmotic flow, the movement of the bulk solution in the capillary, and the more time the solute interacts with the surfactant the longer is its migration time. Of course, MEKC is not limited only to the separation of neutral analytes. It can be used for the simultaneous separation of anionic, cationic, and neutral species. That is the real power of MEKC.

MEKC has been employed for the separation of a wide range of analytes. Some of the applications include the separation of compounds of environmental interest such as polycyclic aromatic hydrocarbons [19, 20], explosive constituents [21], and many of the compounds on the EPA's list of priority pollutants [22,23]. Another area of interest is the separation of biological samples such as amino acids [24-26], proteins [27,28], and a wide range of pharmaceuticals [29-32]. While MEKC is a very useful technique, it does suffer from certain disadvantages. One of the disadvantages is the fact that in order for the surfactant to be effective as a pseudostationary phase in MEKC, it must be at a concentration above its CMC. In addition, the dynamic equilibrium between the free unassociated surfactant molecules and the micelle can lead to a decrease in separation efficiency as compared to a more ordered system. In order to overcome

these disadvantages, Palmer et al. introduced the use of polymeric surfactants (or molecular micelles) [33,34].

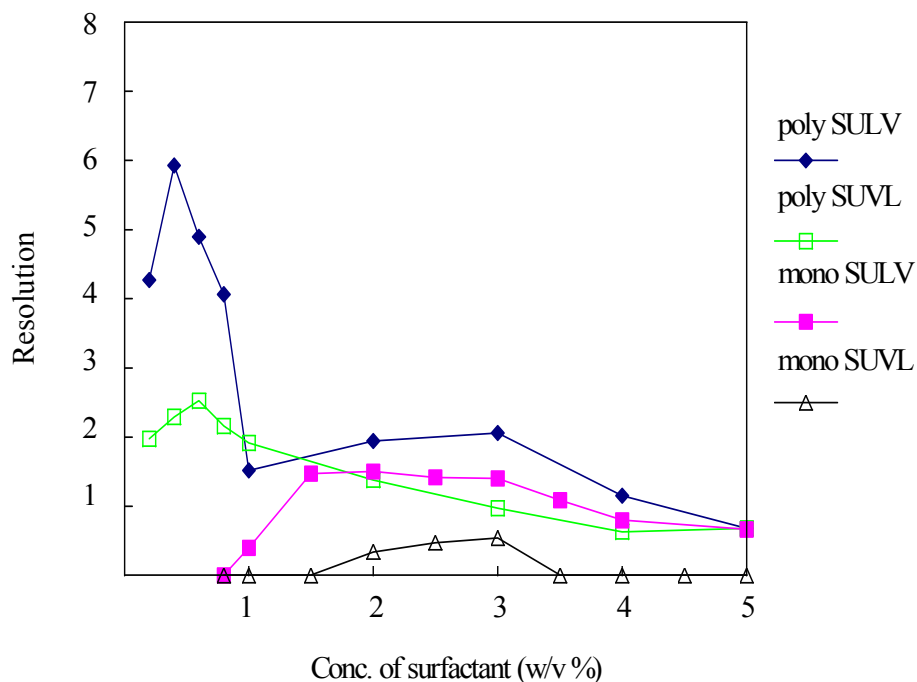
Polymeric surfactants have certain distinct advantages over conventional micelles in MEKC. One advantage of polymerized surfactants is the elimination of the dynamic equilibrium between monomer and micelle. Elimination of the dynamic equilibrium minimizes problems which are often associated with monomers in MEKC such as increase in joule heating which causes a decrease in separation efficiency [35]. Another advantage is the lack of a CMC. Thus, the polymer can be used over a wider range of concentrations than the monomer, e.g. below the normal CMC of the unpolymerized surfactants. The advantage of the polymer over the monomer is illustrated in work done by the PI comparing the separation ability of the monomer and the polymer of two very similar dipeptide surfactants; sodium undecyl leucine valinate (SULV), and sodium undecyl valine leucinate (SUVL).

As can be seen from Figure 2, the monomers of SULV and SUVL show a rapid decrease in resolution as the CMC is approached, the CMC being approximately 10 mM, which is slightly less than 1 % (w/v). The polymers, on the other hand show a significant increase in resolution at concentrations below the normal CMC of the monomers. The optimum resolution ( $R_s$ ) of BOH enantiomers achieved with the monomers of SULV and SUVL was respectively

$R_s < 2$  and  $R_s < 1$ , while the optimum resolutions with the polymers were  $R_s \sim 6$  and  $R_s \sim 3$ , respectively. The polymers were able to resolve enantiomers of BOH approximately three times better than the monomers. Still another advantage is the fact that organic modifiers can be used without disrupting the formation of the micelle [36-39]. Finally, the structural rigidity and purification of the micelle polymer can often improve the mass transfer rate, thus reducing peak broadening [40].

Since the introduction of polymeric surfactants as pseudostationary phases in CE only occurred about ten years ago, the variety of polymeric phases that can be used as pseudostationary phases in CE has barely just begun to be explored. Therefore, in light of the potential demonstrated by CE, and in particular the use of polymeric surfactants as pseudostationary phases in CE, a deeper understanding of the fundamental factors contributing to chemical selectivity in polymeric surfactants is needed. A deeper understanding of these factors will lead to better chemical separations and improved phases. The PI has authored or co-

**Figure 2 Comparison of the monomers and polymers of SUVL and SULV for the enantiomeric separation of BOH.**



authored 19 publications that relate directly to trying to gain insight into the factors that govern selectivity in CE with polymeric surfactants [5,41-57].

### **Relationship of the Educational Activities to the Current State of Knowledge on Effective Teaching and Learning**

There are two different components to the educational activities discussed in this proposal. The first one to be discussed in this section is faculty development. It is interesting that most jobs require a certain amount of on-the-job-training before the employee is allowed to assume their responsibilities. For instance, in order to become a plumber or an electrician, years of training as an apprentice is required. After medical doctors receive their training in the classroom, several years of working as a supervised intern is required. In fact, even to work as a cashier in a grocery store, that employee usually spends about one week in training before they are allowed to do the job unsupervised. Why is it that new faculty responsible for teaching at colleges and universities do not also have to be trained in their jobs? Most new faculty, at least in the sciences, receive little to no training in how to teach prior to assuming their positions at the institution in which they are hired. Many will have worked as teaching assistants in laboratories while they were in graduate school, but this usually amounts to no more than baby-sitting.

The PI has found through many discussion on this topic with other faculty from this university and others that most new faculty struggle through their first two years feeling totally inadequate and basically doing a terrible job teaching. In the third year the faculty member begins to feel a little more comfortable and they begin to make fewer major mistakes. It is not until maybe the fourth or fifth year that the faculty member starts to feel that they can begin doing a fairly good job teaching. However, in the previous three or four years this faculty member has taught probably a couple thousand students. How many of these students became disinterested in science due to the inadequacy of this instructor in his or her early years? Whatever that number is, it is too high. Especially considering the ever-growing need for more people in the work force that are properly trained in the sciences.

The purpose of the faculty development seminars is to decrease the learning curve from 4 or 5 years down to 1 or 2 years. This will be accomplished by requiring “new” faculty to attend a series of weekly seminars specifically designed to give them the knowledge and “experience” needed to be effective teachers. The invited speakers for the faculty development seminars will be experienced faculty members from this university and elsewhere who are recognized leaders in a particular area of teaching or faculty development. The PI is working closely with the Center for Teaching Excellence here on campus, the Dean of the College of Science and Technology, and the Chair of the Department of Physical and Life Sciences on this project. More details about the specifics of this project can be found in the section entitled “Education Activities Outline of the Plan of Work.”

In addition to helping these new faculty become more effective teachers, the seminars are also designed to help the new faculty members become more effective researchers and mentors for undergraduate researchers. Helping the faculty become better researchers and mentors for undergraduate students will greatly enhance the student experience and has the potential to increase the number of minority students from this university interested in pursuing post baccalaureate degrees in science.

The second component of the educational activities is designed to increase the number of underrepresented and economically challenged students interested in pursuing careers in science. This will be accomplished through a program of early involvement of undergraduates in scientific research, mentorship, and community outreach. This educational activity has two

components: outreach and undergraduate research/mentorship. The outreach component focuses on attracting more K-12 students into pursuing careers in science, while the undergraduate research/mentorship aspect emphasizes getting the students already enrolled in science in college to pursue an advanced degree in a science related field.

It has been shown in several studies that undergraduate research experiences translate into a stronger motivation toward academics, a greater interest in learning more sciences, and a desire for continued education in professional or graduate or school. This is especially true when research begins early in their academic career [58,59]. The PI not only plans to recruit undergraduates into his research group, but he will be VERY active in getting more faculty to invite undergraduate students into their laboratory to do research. The PI will do this through various means. One way is by using the Faculty Development Seminars as a tool to show faculty how to best utilize undergraduates in their laboratory. The PI will also be actively involved in seeking funds for these faculty and for the undergraduate students working in their laboratories. The PI has already demonstrated his commitment to this by the REU proposal that he helped write and that was recently funded. The PI of this proposal plans to take advantage of every opportunity that is made available to him to seek funds for undergraduate research and to help this institution grow and develop as a model of undergraduate research and recruitment of minorities into science related fields. The PI's commitment to this endeavor is evident from the number and types of proposals he has written and been Co-PI on in the last two years. A list of these proposals is shown below. As can be seen, the PI of this proposal has been PI or CoPI on 11 proposals written to external funding agencies. Of those 11, six were either instrumental or departmental grants. The PI has also written and received funding for three other proposals (not listed below) that were funded by the university.

#### **Instrumental Grants**

- NSF MRI/RUI, Acquisition of a GC/MS System for Enhancement of Research at Texas A&M University-Corpus Christi, **PI**
- Department of Defense Instrumentation and Research Support for Hispanic Serving Institutions Grant, *Laboratory Instrumentation for Undergraduate Teaching/Research at Texas A&M University-Corpus Christi*, **PI**
- NSF MRI, *Acquisition of Instrumentation for the Chemical and Biological Characterization of Factors Affecting the Distribution and Phytoremediation of Seagrasses in Coastal Bays and Estuaries*, **CoPI**
- Department of Defense Instrumentation grant, *Acquisition of High Field Nuclear Magnetic Resonance Spectrometer to Enhance Teaching/Research in Texas A&M University-Corpus Christi*, **CoPI**

#### **Departmental Grants**

- The Welch Foundation, *Chemistry Departmental Grant*, **CoPI**
- NSF REU, *Summer Undergraduate Research Focus: Anthropogenic Impacts on the Environment*, **CoPI**

#### **Research Grants**

- NIH AREA, *Zebrafish Bioassay for Detection of Endocrine Disruption*, **PI**
- NSF RUI, *Development of a Semiquantitative Screening Method for Pesticides and Endocrine Disruptors*, **PI**
- NSF RUI, *Zebrafish as a Model to Study the Affect of Thyroid Function on Growth and Development*, **CoPI**

- The Welch Foundation, *Investigation of the Guest-Host Interactions of Solid Cyclodextrin with Gaseous PAHs*, **PI**
- The Gulf and South Atlantic Fisheries Foundation, *Sensory and Chemical Assessment of Wild Harvest and Pond Raised Shrimp*, **CoPI**

### Research Outline of the Plan of Work

The research will focus on the synthesis, characterization, and evaluation of several novel monomeric and polymeric surfactants to be used as pseudostationary phases for the separation of compounds of environmental significance using CE. In particular, the research will focus on gaining insight into the factors that govern selectivity with these novel pseudostationary phases. Initially, the research will focus on the synthesis of various novel amino acid and sugar-based surfactants. Once the monomeric and polymeric forms of the individual surfactants have been synthesized, evaluation of the surfactants as pseudostationary phases for CE will begin followed by NMR and fluorescence studies designed to elucidate the types of interactions responsible for separation. A timetable for the proposed research activities is shown in Table 1.

The proposed “ideal” plan of work follows. However, since this work will be done almost exclusively by different undergraduate students during the course of the five years, the stage at which each student will be at will vary.

**Table 1. Five Year Research Plan**

Activity	Year 1	Year 2	Year 3	Year 4	Year 5
Synthesis of monomeric and polymeric surfactants					
Evaluation of surfactants as suitable pseudostationary phases for the analytical separation of environmentally significant analytes					
Molecular spectroscopic studies of surfactants and surfactant/analyte interactions					
Use information gathered to elucidate types of interactions responsible for separation					

**Synthesis of surfactants** – As an undergraduate student joins the PI’s research group, they will be assigned a particular surfactant, or group of surfactants, to synthesize and study. They will be taught the synthetic procedure either by the PI or one of the more experienced members of the research team. The student will be expected to characterize the product after each step of the synthetic procedure by use of infrared spectroscopy, mass spectrometry, and NMR to ensure that the synthetic procedure has produced the desired product. After the student has successfully synthesized, purified, and verified the existence of the desired surfactant, the

student will then begin characterization of the physical properties of the surfactant and evaluate its potential as a pseudostationary phase in CE.

**Characterization of the physical properties of the surfactant** - Some of the physical properties which will be studied include but are not limited to:

- The critical micelle concentration (CMC) of the surfactants will be determined using two different techniques: by use of a tensiometer and one of several possible fluorescence quenching methods [60].
- The aggregation number of the surfactants will be determined by following a fluorescence quenching method developed by Turro [61]. A brief description of this method can be found in the next section, *Research Methods and Procedures to be Used*.
- A variety of molecular probes will also be used to examine the microenvironment inside the micellar core of the surfactant(s). Some of the physical properties that will be examined include but are not limited to viscosity and polarity. This information will be used to gain insight into the similarities and differences of the various surfactants under study.

**Evaluation of surfactant(s) as a suitable pseudostationary phase for analytical separation of compounds of environmental significance** – This part of the project involves exploring the ability of the surfactant(s) under study to separate compounds of environmental significance using capillary electrophoresis. The students will be expected to choose a group of analytes to be separated, determine the optimum separation conditions for that group of analytes with the surfactant under study and then compare the separation efficiency of that surfactant with other surfactants in our laboratory and/or with other systems described in the literature.

**Examination of analyte/surfactant interactions** - The two main techniques that will be used to study analyte/surfactant interactions are fluorescence and NMR. When appropriate (if the analyte of interest fluoresces) fluorescence anisotropy and quenching studies will be used to calculate binding constants for analyte/surfactant interactions. A description of the methods and procedures to be used to examine analyte/surfactant interactions can be found in the next section, *Research Methods and Procedures to be Used*.

Initially, the NMR work may be performed by one of the collaborators of the PI on this proposal, Dr. Kevin Morris, and his students at Carthage College until we acquire an NMR at TAMUCC. We are currently seeking funds for a 300 megahertz NMR. We expect to have funding approved for an NMR by the time funds from this proposal are made available or shortly thereafter. If not, all the NMR analysis will be performed by Dr. Morris and his students until such time as we acquire our own NMR. After such time, collaboration between Dr. Morris and the PI of this proposal will continue because of his expertise, and the specialized equipment available to Dr. Morris to conduct some experiments that we are not requesting funding for in our NMR proposal.

## **Research Methods and Procedures to be Used**

### **Synthetic Procedures**

Anionic amino acid based surfactants will be synthesized from the N-hydroxysuccinimide ester of undecylenic acid according to a previously reported procedure [62]. The acid forms of these surfactants will then be converted to the sodium salt by addition of equimolar concentrations of sodium bicarbonate in the presence of methanol. The sodium salt of the surfactants will then be obtained by evaporating the solvent and freeze-drying. Cationic surfactants will be synthesized using undecylenic amine and the N-hydroxysuccinamide ester of the protected amino acid or dipeptide and will be cleaned up similar to the anionic surfactants.

Neutral sugar surfactants will be synthesized using a modified (vinyl terminated hydrophobic group) method reported by Haclanova et al. [63] and Costes et al. [64]. In addition, sugar surfactants with amide linkage will be synthesized using the glucosamine and the N-hydroxysuccinimide ester of undecylenic acid [65]. An alternative method would be used if the starting material for the sugar moiety contains a carboxylic group. The carboxylic group would be activated by forming the N-hydroxysuccinimide ester of that carboxylic sugar and it would then be coupled to the hydrophobic moiety by reaction with undecylenic amine. The undecylenic amine will be synthesized from undecylenic alcohol using Gabriel synthesis [66]. An aqueous solution of the monomer will then be polymerized using either UV-irradiation [67] or free radical polymerization [68]. Proton NMR spectroscopy will be used to confirm polymerization.

### NMR Studies

Two-dimensional NMR techniques such as COSY, TOCSY, NOESY, and ROESY will be used to carry out investigations of the surfactant conformation in monomer and micellar form [48]. These same 2D-NMR techniques will also be used to characterize the interaction between analytes and surfactants. For example, NOESY and ROESY will allow us to determine which analyte-surfactant protons are in close spatial proximity, thus allowing us to investigate the mechanism of the analyte binding process.

In addition, Diffusion Ordered NMR Spectroscopy (DOSY) will be used to investigate the association equilibria that govern the analyte-surfactant interactions. In this 2D-NMR experiment, conventional chemical shift spectra are displayed in one dimension, while translational diffusion coefficients are displayed in the other [69]. Therefore, in a surfactant-analyte mixture, diffusion coefficients can be determined for both components in a single experiment. If a second DOSY experiment is used to establish the analyte's free solution diffusion coefficient, then a two-site model of analyte binding can be used to calculate the mole fraction of bound compounds and the analyte-surfactant association constant. By establishing these association constants for surfactants with different headgroups, the fundamental thermodynamics that govern the analyte-surfactant interactions can be investigated.

### Fluorescence Studies

- **Determination of Aggregation Number** - The quenching of the pyrene by N-acetylpyridinium chloride is measured at  $\lambda_{\text{ex}}=337$  and  $\lambda_{\text{em}}=392$  nm [60]. Using the following expression where  $C_s$  is the total surfactant concentrations,  $I_0$  and  $I$  are the relative fluorescence intensity of the pyrene at zero and  $[Q]$  concentrations. The aggregation number,  $N$ , of the surfactants, is obtained from the slope of the plot of  $\ln(I_0/I)$  vs.  $[Q]$ .

$$\ln(I_0 / I) = \frac{N[Q]}{(C_s - CMC)}$$

- **Determination of CMC** – The CMC of the surfactant will be determined by measuring the change in fluorescence of Acridine Orange as a function of surfactant concentration [70]. The quenching of the Acridine Orange will be measured at  $\lambda_{\text{ex}}=337$  and  $\lambda_{\text{em}}=392$  nm. A plot of fluorescence versus concentration results in a sigmoidal curve. The concentration of surfactant at the midpoint of the sigmoidal curve is the calculated CMC.

### **Capillary Electrophoresis Studies**

Several different operating parameters will be varied to determine optimum separation conditions for the various surfactants and the analytes of interest to be separated. Some of these parameters include pH, type and concentration of buffer, temperature of capillary column, type and concentration of organic modifiers to be used as mobile phase additives, and most importantly – concentration of surfactant.

### **Education Activities Outline of the Plan of Work**

There are three components to the educational activities. The first component centers around exposing undergraduate students early on in their academic careers to research. In particular, the focus of the PI's recruitment efforts will be from groups who historically have been under-represented in science. The outline of the plan of work for the research/mentoring portion of the educational component has been previously discussed. The PI plans to identify and recruit the undergraduate researchers at the end of their freshman year after they have completed general chemistry. The PI will then coordinate the coursework and the research in such a way that the knowledge level required to properly perform their research will match and reinforce material being taught in their courses.

Another component of the educational activities the PI is, and will be involved with is related to community outreach. The PI has been the faculty representative for the last two years of a student organization here on campus called the Corpus Christi Chemistry Club. At the PI's suggestion, the club has begun giving science demonstrations at local K-12 schools to get students interested in science. These demonstrations have been focused on chemistry demonstrations for the last two years. The demonstrations have been very successful to date for both our students and the children at the local K-12 schools they have visited. The chemistry club is now planning to get other science clubs here on campus involved to give more demonstrations on topics other than just chemistry. The PI plans to champion this project and help direct and coordinate these activities. The PI, along with the students, will design a group of demonstrations that would not only excite the K-12 students about science, but would also serve to educate these students about some of the environmental issues facing the local community and the world at large. For instance, one could begin the demonstration/awareness program by doing a simple flame test of various metals to demonstrate that different metals have characteristic colors which can be used to identify and quantify these metals not only in the environment around us but also on distant stars. All the demonstrations would be designed such that it could serve as a teaching tool for the student demonstrator to introduce a different concept related to environmental issues.

The last component of the educational activities has to do with the training of new faculty members in areas pertaining to teaching and research. As previously mentioned, most faculty teaching at colleges and universities, particularly in the sciences, get their Ph.D. doing research with little to no training or experience in teaching. This problem is one that needs to be addressed not only at this institution, but nationwide. Recognizing this deficiency in the system, the PI after consultation with the Chair of his department Dr. Grady Blount, and with the encouragement and support of the Dean of Science and Technology, Dean Diana Marinez, along with the help and support of Dean Harvey Knull, Graduate Dean and Associate Vice President of Research & Scholarly Activity, began a series of weekly seminars last year designed to help new faculty learn to become more effective teachers and researchers. The first semester seminar series focused primarily on teaching and faculty responsibilities. A list of some of the topics covered in the first semester included:

- What is the Tutoring and Learning Center and how can they help us and our students?
- How to write effective tests
- What can the Center for Teaching Excellence do to help new faculty?
- Teaching resources
- The do's and don'ts of using Power Point
- How to use the Web effectively in the classroom
- Things new faculty members should know about promotion and tenure
- How to keep your head above water in your first year of teaching
- How knowing about learning styles can make you a more effective teacher
- Incorporating inquiry-based teaching into your labs and lectures

The second semester focused almost exclusively on grantsmanship and research. These seminars were much less structured and relied more on faculty forming a dialog with the Office of Sponsored Research managed by Dean Harvey Knull and his staff. However, some of the topics discussed in these seminars were:

- What type of research is currently being conducted on campus and by whom?
- The importance of networking and attending conferences
- What are some of the various funding agencies and what do they fund?
- Grant writing tips
- How do you find out who is funding the research you are interested in.

In addition, to the discussion on the various topics listed above, a large portion of the time was spent critiquing proposals that had already been submitted or were in preparation.

Initially, the seminars were designed for new faculty in the Department of Physical and Life Sciences. However, due to the phenomenal success and interest in these seminars this upcoming year the seminars will not only include all of the new faculty in the Department of Physical and Life Sciences but all new faculty in the College of Science and Technology as well. In fact, while attendance the first year was voluntary, the Dean of the College of Science and Technology has decided to tie faculty release time, given the first year of employment at TAMUCC, to mandatory attendance at these meetings. In addition, because many of the "older" faculty also expressed a great deal of interest in these seminars, the seminars will no longer be called "New Faculty Seminars", but rather "Faculty Development Seminars" and all faculty will be invited to attend. The PI plans to continue developing these seminars over the course of the next five years and beyond and to work on other areas of improving faculty training. The faculty development seminars are the first step in developing a systemic change in the way this university and others view their role and responsibility to the faculty as well as the student in terms of helping faculty develop their potential.

#### **Evaluation of Educational Activities**

Questionnaires will be designed to evaluate the success of the various components of the educational activities. These questionnaires will be designed to determine such factors as knowledge gained from the various educational activities to potential affect the activities may have on the participants. For instance, questionnaires will be given to the students a week or so before the team of undergraduate students goes to their school to give the demonstrations. The survey/questionnaire will ask questions pertaining to attitude towards science, knowledge of environmental issues that will be part of the demonstration, and about the scientific concepts that will be demonstrated and discussed. A follow-up survey/questionnaire will be administered by the teacher of that class a week or so following the demonstration to compare the results before and after the visit.

Evaluation of the faculty development seminars will be determined in much the same way. The “new” faculty will be asked to fill out a survey/questionnaire at the beginning of their first semester at TAMUCC, at or before the first faculty development seminar. That faculty will then be given a survey/questionnaire at the end of each of the first two semesters to determine faculty attitudes towards the seminars and what type of information they gained from attending these seminars.

Evaluating the success of the research/mentoring component will be determined by the percentage of undergraduates doing research in the PIs laboratory who go on to pursue post-baccalaureate degrees. The mentoring effort will be considered successful if 50% or greater of the students coming into the PI’s laboratory under this program remain in the program until they graduate and if 75% of these students go on to pursue advanced degrees.

### **Relationship of the Plan to the PI’s Career Goals and Job Responsibilities and to the Goals of the Department and University**

The research and educational goals described in this proposal match that of the University’s as exemplified by the following statement which comes from the University’s Statement of Purpose: *“Texas A&M University-Corpus Christi is committed to the pursuit of excellence in instruction, research and other forms of scholarly activity, and public service. Consistent with this commitment, the University seeks to identify, recruit and retain students who have high potential for academic success, especially those from groups who historically have been under-represented in higher education.”* Thus, the emphasis on the recruitment of first generation college students coming from economically challenged backgrounds matches the University’s goal since most of the students matching that description here in South Texas are of Hispanic origin and they are very poorly represented in sciences.

The outreach program as described in this proposal is also in line with the University’s commitment to the pursuit of excellence in instruction, research and other forms of scholarly activity, and public service. The outreach program is designed as a public service to interest more students in science careers and raise the awareness of these students to the environmental issues facing the local, as well as the global community.

The relationship of the faculty development aspect discussed in this proposal to the goals of the department and university and to the PIs career goals and responsibilities is best understood by the tremendous support and encouragement he has received from the Chair of the Department of Physical and Life Sciences, the Dean of the College of Science and Technology, and from the Graduate Dean and Associate Vice President of Research & Scholarly Activity.

### **Summary of Prior Research and Educational Accomplishments**

The PI of this proposal has extensive experience and success with research directly related to that described in this proposal. The PI has authored five papers, four of which were published in the Journal of Analytical Chemistry, on topics related to understanding analyte interactions with organized media [5,45,50- 52]. In addition to the five articles the PI authored, the PI is also coauthor on nine other publications in peer-reviewed journals with six other publications either in press or submitted for publication [41-44,46-49, 53-60]. Nineteen of the 20 publications the PI has authored or co-authored, are related to understanding analyte interactions with organized media. The PI of this proposal also shares a patent with Dr. Isiah Warner entitled, *Polymerized Oligopeptide-Surfactant Chiral Micelles* [71].

Since his arrival at TAMUCC, the PI’s research focus has been primarily geared towards environmental research. In research not directly related to the research component described in this proposal, the PI of this proposal has assembled a team of interdisciplinary researchers here at

TAMUCC who are examining the distribution, fate, and effect of endocrine disruptors in the environment and on the development of bioassays to screen for endocrine disruption activity in the environment. That research team consists of one other chemist, four biologists (two embryologist, one molecular biologist, and one immunologists) and one faculty member interested in marine aquaculture (Mariculture). While the endocrine disruption research is not a part of the research component of this proposal, it is relevant in terms of the educational component of this proposal. The students working on the endocrine disruption project are part of a team of undergraduate and graduate researchers who work together to try solve a very complex and difficult problem.

The students working in the PI's lab on the endocrine disruption project do everything from collection, extraction, cleanup and analysis of air, water, and sediment samples to rearing and testing the affects of endocrine disrupters and extracts of environmental samples on our test organism (zebrafish embryos). Some of the PI's students are also using fluorescence to help gain insight into the molecular interactions of various endocrine disruptors with proteins or other hormone regulators in the body. In addition, we encourage our students to also work with other faculty members working on other aspects of the endocrine disruption project. Some of the other research being conducted includes: 1) performing histological studies on zebrafish and chick embryos exposed to known or suspected endocrine disruptors as well as those exposed to extracts of environmental samples, 2) examination and use of genetically modified yeast strains to screen for endocrine disruption activity, and 3) performing test to determine which genes or proteins are being expressed upon exposure of the zebrafish to known or suspected endocrine disruptors and extracts of environmental samples. The student researchers working with all the faculty meet regularly to help promote teamwork and facilitate a deeper understanding of the overall goals and objectives of the endocrine disruptor project.

This same type of model will be used for the students working on the research project described in this proposal. The students will not only be trying to understand the surfactant(s) they synthesized, they will also have to try to relate that information to the information obtained by their fellow researchers working on other surfactants. The PI realizes this is a difficult project for undergraduate students to undertake. However, if the students start very early in their undergraduate career on this project they should be able to meet the goals set forth for them. In so doing they will gain confidence and a much deeper understanding of the interrelationship of not only the various disciplines of chemistry, but how their research relates to solving some of the environmental issues facing modern society. Since the students working on the surfactant study are part of the same research group working on the endocrine disruption project, the students in the PI's research group will also be able to be exposed to all the discussion related to that research during group meetings and general discussions in the laboratory. This will be of great benefit to the students in allowing them to grow as scientist and develop and keep a broad perspective of the problems we in our modern society are facing and realize that in order to solve these problems it will take a great deal of teamwork and interdisciplinary support.

The educational accomplishments of the PI are closely linked to his research accomplishments. As mentioned previously, the PI of this proposal has been employed at TAMUCC for three years and has only been conducting research for the last two years. In that short two-year period, the PI has had fifteen undergraduate students doing research in his lab, fourteen of which were being supported financially to do research. Of those fifteen students 11 were minority or female. Of the four white males that were doing research in his laboratory, two were first generation college students. The PI is firmly committed to the idea that the best way

to positively impact a student's life is to reach out and make a genuine connection to the student. The PI often spends half his day mentoring students from problems they are having with research or in class to personal problems they are having in their lives.

One of the things that the PI tries very hard to do with his students is to give them the knowledge they need in order to have proper perspective about their future. The PI has noticed that most of the first generation college students coming from economically challenged backgrounds are totally unaware of their ability to pursue a post baccalaureate degree. The two main obstacles facing these students are self-image and financial considerations. Most of these students do not feel they are smart enough to get a Ph.D. because they have never had an appropriate role model in their life. In addition, most also feel that attending graduate schools is outside of their reach financially because of the debt they have accrued in getting their bachelors degree. The PI spends countless hours explaining to these students that most graduate schools will pay them to go to school either as a teaching assistant or as a research assistant. In addition, countless more hours are spent tearing down the idea that graduate school is for other people, not for insignificant people like themselves.

On a personal note, since the PI is a Native American and comes from a family of twelve children with parents who had little to no formal education, the PI is able to connect with these students on a very personal level. This connection is extremely important for effective mentorship. The PI of this proposal did two years of undergraduate research which helped guide him to his Ph.D. Therefore, this PI recognizes the importance of undergraduate research as a means to mentor students who would not otherwise consider pursuing an advanced degree in science. The PI of this proposal is dedicated to helping improve the lot of "economically challenged" individuals which a disproportionate number of minority students fall into.

## REFERENCES

1. National Science Foundation. *Women, Minorities, and Persons With Disabilities in Science and Engineering*: **2000**. Arlington, VA, (NSF 00-327).
2. Smith, R. D., Olivares, J. A., Nguyen, N. T., and Udesch, H. R. "Capillary Zone Electrophoresis-Mass Spectrometry Using an Electrospray Ionization Interface" *Anal. Chem.*, **1988**, 60, 436.
3. Guttman, A., Cohen, A. S., Heiger, D. N., and Karger, B. L. "Analysis and Micropreparative Ultrahigh Resolution of Oligonucleotides by Polyacrylamide Gel High-Performance Capillary Electrophoresis" *Anal. Chem.*, **1990**, 62, 137.
4. Dadoo, R., Zare, R. N., Yan, C., Anex, D. S. "Advances in Capillary Electrochromatography: Rapid and High-Efficiency Separations of PAHs" *Anal. Chem.*, **1998**, 70, 4787.
5. Billiot, E.; Macossay, J., Thibodeaux, S., Shamsi, S. A., Warner, I. M. "Chiral Separations Using Dipeptide Polymerized Surfactants: Effect of Amino Acid Order" *Anal. Chem.*, **1998**, 70, 1375.
6. Edstrom, J. E. "Nucleotide analysis on the cyto-scale" *Nature*, **1953**, 172, 908.
7. Turner, B. M. "Quantitative Microscopic Ionophores and Chromatography" *Nature*, **1957**, 179, 964.
8. Turner, B. M. "Ionophoretic and Chromatographic Analysis of Single Dust Particles" *Nature*, **1958**, 3, 20.
9. Mاتيoli, G. T., Niewisch, H. B. "Electrophoresis of Hemoglobin in Single Erythrocytes" *Science*, **1965**, 150, 1824.
10. Poehling, H. M., Neuhoff, V. "One and Two Dimensional Microelectrophoresis and Staining of Proteins with a Silver Method" *Electrophoresis*, **1981**, 133.
11. Neuhoff, V., Schill, W. B., Sternbach, H. "Microanalysis of Pure Deoxyribonucleic Acid-Dependent Ribonucleic Acid Polymerase from *Escherichia coli*" *Biochem. J.*, **1970**, 117, 623.
12. Li, S. F. Y. "Capillary Electrophoresis Principal, Practice, and Applications" Elsevier Science Publisher, Amsterdam, **1992**.
13. Hejerten, S. "Free Zone Electrophoresis" *Chromatogr. Rev.*, **1967**, 9, 122.
14. Mikkers, F. E., Everaerts, F. M., Verheggen, T. P. "High performance zone electrophoresis" *J. Chromatogr.*, **1979**, 169, 11.
15. Miller, J. L., Khaledi, M. G., Shea, D. "Separation of Polycyclic Aromatic Hydrocarbons by Nonaqueous Capillary Electrophoresis Using Charge-Transfer Complexation with Planar Organic Cations" *Anal. Chem.*, **1977**, 69, 1223.
16. Jorgenson, J. W., Lukacs, K. D. "Zone Electrophoresis in Open-Tubular Glass Capillaries" *Anal. Chem.*, **1981**, 53, 1298.
17. Jorgenson, J. W., Lukacs, K. D. "Capillary Zone Electrophoresis" *Science*, **1983**, 222, 266.

18. Terabe, S., Otsuka, K., Ichikawa, K., Ando, T. "Electrokinetic Separations with Micellar Solutions and Open-Tubular Capillaries" *Anal. Chem.*, **1984**, 56, 111.
19. Northrop, D. M., Martire, D. E., Maccreehan, W. A. "Separation and Identification of Organic Gunshot and Explosive Constituents by Micellar Electrokinetic Capillary Electrophoresis" *Anal Chem.*, **1991**, 63, 1038.
20. Shamsi, S. A., Akbay, C., Warner, I. M. "Polymeric Anionic Surfactant for Electrokinetic Chromatography: Separation of 16 Priority Polycyclic Aromatic Hydrocarbon Pollutants" *Anal. Chem.*, **1998**, 70, 3078.
21. Halasz, A., Groom, C., Zhou, E., Paquet, L., Beaulieu, C., Deschamps, S., Corriveau, A., Thiboutot, S., Ampleman, G., Dubois C., Hawari, J. "Detection of explosives and their degradation products in soil environments" *J. Chromatogr. A*, **2002**, 963, 411.
22. Morales, S., and Cela, R. "Capillary Electrophoresis and Sample Stacking in Non-aqueous Media for the Analysis of Priority Pollutant Phenols" *J. Chromatogr. A*, **1999**, 846, 401.
23. Guang, L., and Locke, D. "Nonionic Surfactants for Improving Resolution of the Priority Pollutant Phenols by Micelle-modified Capillary Electrophoresis" *J. Chromatogr. A*, **1996**, 734, 357.
24. Agnew-Heard, K. A., Sanchez Pena, M., Shamsi, S. A., Warner, I. M. "Studies of Polymerized Sodium *N*-Undecylenyl-L-valinate in Chiral Micellar Electrokinetic Capillary Chromatography of Neutral, Acidic, and Basic Compounds" *Anal. Chem.*, **1997**, 69, 958.
25. Tickle, D. C., Okafu, G. N., Camilleri, P., Jones, R. F. D., Kirby, A. J. "Glucopyranoside-Based Surfactants as Pseudostationary Phases for Chiral Separations in Capillary Electrophoresis" *Anal. Chem.*, **1994**, 66, 4121.
26. Dobashi, A., Ono, T., Hara, S., Yamaguchi, J. "Enantiomeric Separation of Sodium Dodecanoyl-L-amino Acetate Micelles and Poly (Sodium(10-undecenoyl)-L-valinate) by Electrokinetic Chromatography" *Anal. Chem.*, **1995**, 67, 3011.
27. Cohen, A., Terabe, S., Smith, J., Karger, B. "High-Performance Capillary Electrophoresis Separation of Bases, Nucleosides, and Oligonucleotides: Retention Manipulation via Micellar Solutions and Metal Additives" *Anal. Chem.*, **1987**, 59, 1021.
28. Song, S., Zhou, L., Thompson, R., Yang, M., Ellison D., and Wyvratt, J. "Comparison of Capillary Electrophoresis and Reversed-phase Liquid Chromatography for Determination of the Enantiomeric Purity of an M3 Antagonist" *J. Chromatog. A*, **2002**, 959, 299.
29. Clothier, J. G., Tomellini, S. A. "Chiral Separation of Verapamil and Related Compounds Using Micellar Electrokinetic Capillary Chromatography with Mixed Micelles of Bile Salts and Polyoxyethylene Ethers" *J. Chromatog. A.*, **1996**, 723, 179.
30. Clothier, J. G., Daley, I. M., Tomellini, S. A. "Effects of Bile Salt Structure on Chiral Separations with Mixed Bile Salts and Polyoxyethylene Ethers Using Micellar Electrokinetic Chromatography" *J. Chromatog. B.*, **1996**, 683, 37.

31. Fanali, S. "Identification of Chiral Drug Isomers by Capillary Electrophoresis" *J. Chromatog. A.*, **1996**, 735, 77.
32. Altria, K. D. "Determination of Drug-related Impurities by Capillary Electrophoresis" *J. Chromatog. A.*, **1996**, 735, 43.
33. Palmer, C. P., McNair, J. "Novel Pseudostationary Phase for Micellar Electrokinetic Capillary Chromatography" *J. Microcol. Sep.*, **1992**, 4, 509.
34. Palmer, C. P., Khaledi, M. Y., McNair, J. "A Monomolecular Pseudostationary Phase for Micellar Electrokinetic Capillary Chromatography" *J. High Resolut. Chromatogr.*, **1992**, 15, 756.
35. Palmer, C. P. "Micelle Polymers, Polymer Surfactants and Dendrimers as Pseudostationary Phases in Micellar Electrokinetic Chromatography" *J. Chromatogr. A*, **1997**, 780, 75.
36. Palmer, C. P., Tanaka, K. "Selectivity of Polymer and Polymer-Supported Pseudostationary Phases in Micellar Electrokinetic Chromatography" *J. Chromatogr. A*, **1997**, 792, 105.
37. Ozaki, H., Ichihara, A., Terabe, S. "Micellar Electrokinetic Chromatography: Perspectives in Drug Analysis" *J. Chromatogr. A*, **1996**, 709, 3.
38. Fujimoto, C., Fujise Y., and Kawaguchi, S. "Macromolecular Surfactant as a Pseudostationary Phase in Micellar Electrokinetic Capillary Chromatography" *J. Chromatog. A*, **2000**, 871, 415.
39. Palmer, C. P., Terabe, S. "Micelle Polymers as Pseudostationary Phases in MEKC: Chromatographic Performance and Chemical Selectivity" *Anal. Chem.*, **1997**, 69, 1852.
40. Shamsi, S.A., Palmer, C.P., and Warner, I.M. "Molecular Micelles: Novel Pseudostationary Phases for Capillary Electrophoresis" *Anal. Chem.*, **2001**, 73, 140A.
41. Thibodeaux, S., Billiot, E., and Warner, I. M., "Enantiomeric Separations Using Poly(L-valine) and Poly(L-leucine) Surfactants; Investigation of Steric Factors Near the Chiral Center" *J. Chromatog. A*, **2002**, 966, 179.
42. Haddadian Billiot, F., Billiot, E.J., and Warner, I.M. "Depth of Penetration of Binaphthyl Derivatives Into the Micellar Core of Sodium Undecenoyl Leucyl-leucinate Surfactants" *J. Chromatogr. A*, **2002**, 950, 233.
43. Haddadian Billiot, F., McCarroll, M., Billiot, E., Rugutt, J., Warner; I. M. "Comparison of the Aggregation Behavior of 15 Polymeric and Monomeric Dipeptide Surfactants in Aqueous Solution" *Langmuir*, **2002**, 18, 8, 2993.
44. Haddadian, F., Billiot, E., and Warner, I. "Comparison of Monomeric and Polymeric Amino Acid Based Surfactants for Chiral Separations" *J. Chromatog. A*, **2001**, 922, 329.
45. Billiot, E., and Warner, I. "Examination of Structural Changes of Polymeric Amino Acid-Based Surfactants on Enantioselectivity: Effect of Amino Acid Order, Steric Factors, and Number and Position of Chiral Centers" *Anal. Chem.*, **2000**, 72, 1740.

46. Haynes III, J., Billiot, E., Yarabe, H., Shamsi, S., and Warner, I. "Chiral Separations with Dipeptide Terminated Polymeric Surfactants: The Effect of an Extra Heteroatom on the Polar Head Group" *Electrophoresis*, **2000**, 21, 1587.
47. Yarabe, Y., Billiot, E., and Warner, I. M. "Enantiomeric Separations by Use of Polymeric Surfactant Electrokinetic Chromatography" *J. Chromatog. A*, **2000**, 875, 179.
48. Rugutt, J. K., Billiot, E. J., and Warner, I. M. "An NMR Study of Chiral Recognition Relevant to Capillary Electrophoresis Separation of Enantiomers by Polymeric Surfactants" *Langmuir*, **2000**, 16, 3022.
49. Haddadian, F., Billiot, E. J. Shamsi, S. A. Warner, I. M. "Chiral Separations Using Polymeric Dipeptide Surfactants: Effect of Number of Chiral Centers and Steric Factors" *J. Chromatogr. A*, **1999**, 858, 219.
50. Billiot, E., Agbaria, R., Thibodeaux, S., Shamsi, S. A. and Warner, I. M. "Amino Acid Order in Polymerized Dipeptide Surfactants: Effect on Physical Properties and Enantioselectivity" *Anal. Chem.*, **1999**, 71, 1252.
51. Billiot, E., Thibodeaux, S., Shamsi, S., Warner, I. M. "Evaluating Chiral Separation Interactions by Use of Diastereomeric Polymeric Dipeptide Surfactants" *Anal. Chem.*, **1999**, 71, 4044.
52. Billiot, E., and Warner, I. "Optimization Studies of Twelve Chiral Analytes with Eight Amino Acid Based Polymeric Chiral Surfactants" submitted to Journal of Chromatography A in Press.
53. Thibodeaux, S., Billiot, E., Torres, E., and Warner, I. "The Effect of Increasing Steric Factors of the Side Chain on Enantiomeric Separations using Polymeric Surfactants" submitted to Analytical Chemistry.
54. Thibodeaux, S. J., Billiot, E. J., and Warner, I. M. "Enantiomeric Separations Using Polymeric L-Glutamate Surfactant Derivatives: Effect of Increasing Steric Factors" submitted to Electrophoresis.
55. Thibodeaux, S. J., Billiot, E. J., and Warner, I. M. "Enantiomeric Separations using Poly L-Valine and Poly L-Leucine Surfactants Investigation of Steric Factors Near the Chiral Center" submitted to Langmuir.
56. Harrell, C. W., Morris, K. F., McCarroll, M. E., Billiot, E. J., and Warner, I. M. "Nuclear Magnetic Resonance, Fluorescence, and Capillary Electrophoretic Studies of the Effect of Polymerization Concentration on the Properties of a Chiral Polymeric Surfactant" submitted to Langmuir.
57. Billiot, Fereshteh H., Billiot, Eugene J., and Warner, I. M. "Depth of Penetration of Binaphthyl Derivatives into Micellar Core of Sodium Undecenoyl Leucyl-leucinate Surfactants" submitted to Journal of Chromatography A.
58. Tuss P., and Smalley L. "Introducing Undergraduates to Research: Long-Term Impacts of the D.O.E. Student Research Participation Program" *CUR Quarterly* **1994**, 15, 65.
59. Mabrouk P., and Peters K. "Student Perspectives on Undergraduate Research Experiences in Chemistry and Biology" **2000**, 21, 25.

60. Turro, N. J., Yekta, A. "Luminescent Probes for Detergent Solutions. A Simple Procedure for Determination of the Mean Aggregation Number of Micelles" *J. Am. Chem. Soc.*, **1978**, 100, 5951.
61. Lakowitz, J. "Principles of Fluorescence Spectroscopy" Kluwer Academic Publishers, Dordrecht, The Netherlands, **1999**.
62. Wang, J., Warner, I. M. "Chiral Separations Using Micellar Electrokinetic Capillary Chromatography and a Polymerized Chiral Micelle" *Anal. Chem.*, **1994**, 66, 3773.
63. Havlinova, B., Kosik, M., Kovac, P., and Blaze, A. "Synthesis and Properties of Surfactants Based on Carbohydrates I, Synthesis of Some O-Dodecyl Aldoses" *Tenside Detergents*, **1978**, 15, 72.
64. Costes, F., Ghoul, M. El., Bon, M., Rico-Lattes, I., and Lattes, A. "Synthesis and Structural-Analysis of Long-Chain N-Acetyl-N-Alkylactosylamines, A New Series of Surfactants Derived From Unprotected Lactose" *Langmuir*, **1995**, 11, 3644.
65. Unpublished work previously performed by the PI.
66. Hendrickson, J., and Bergeron, R. "Triflamides for Protection and Monoalkylation of Amines and a New Gabriel Synthesis" *Tetrahedron Letters*, **1973**, 39, 3839.
67. Dobashi, A., Hamada, M., Dobashi, Y., and Yamaguchi, J. "Enantiomeric Separation with Sodium Dodecanoyl-L-amino Acidate Micelles and Poly(Sodium(10-undecanoyl)-L-valinate) by Electrokinetic Chromatography" *Anal. Chem.*, **1995**, 67, 3011.
68. Nagai, K., Elias, H.-G. "Polymerizable Amphiphiles 3. Polymerization of Micellized 1-0-3-(4-vinylphenol) Propyl- $\beta$ -D-glucopyranose" *Makromol. Chem.*, **1987**, 188, 1095.
69. Morris, K. F., Johnson, C. S., Wong, T. C. "Polymer-Induced Non-Newtonian to Newtonian Transition in the Viscoelastic CTAB/Sodium Salicylate/Water System as Studied by Diffusion-Ordered 2D NMR" *J. Phys. Chem.*, **1998**, 98, 603.
70. Rujimethabhas, M., and Wilairat, P. "Determination of Critical Micelle Concentration using Acridine Orange Dye Probe" *J. Chem. Ed.*, **1978**, 55, 342.
71. Patent # US6270640: "Polymerized Oligopeptide-Surfactant Chiral Micelles," **2001**.

## Eugene J. Billiot

Assistant Professor of Environmental/Analytical Chemistry, Texas A&M University-Corpus Christi, 6300 Ocean Drive, Corpus Christi, TX 78412.

Phone (361) 825-2680, Fax (361) 825-2742

email address: ebilliot@falcon.tamucc.edu

### A) PROFESSIONAL PREPARATION

Ph.D., Analytical Chemistry, Louisiana State University, 1998

B.S., Chemistry, Nicholls State University, 1992

Attended St. Joseph Seminary College as student of philosophy and religion, September 1976 - May 1978.

### B) APPOINTMENTS Professional Experience (Chemistry Related)

9/99 – present Assistant Professor of Environmental/Analytical of Chemistry, Texas A&M University-Corpus Christi

1/94 – 8/99 Research Assistant, Teaching Assistant, Postdoctoral Research Associate, Louisiana State University

10/88 – 5/95 Assistant Laboratory Manager, Marine Shale Processors

9/85 – 5/87 Research Assistant, Nicholls State University

### C) PUBLICATIONS

- Eugene Billiot, and Isiah M. Warner, “Examination of Structural Changes of Polymeric Amino Acid-Based Surfactants on Enantioselectivity: Effect of Amino Acid Order, Steric Factors, and Number and Position of Chiral Centers”, *Analytical Chemistry*, **2000**, 72, 1740-1748.
- Eugene Billiot, Rezik Agbaria, Stefan J. Thibodeaux, Shahab A. Shamsi, and Isiah M. Warner, “Amino Acid Order in Polymerized Dipeptide Surfactants: Effect on Physical Properties and Enantioselectivity”, *Analytical Chemistry*, **1999**, 71, 1252-1256.
- Eugene Billiot, Stefan J. Thibodeaux, Shahab A. Shamsi, and Isiah M. Warner, “Evaluating Chiral Separation Interactions by Use of Diastereomeric Polymeric Dipeptide Surfactants”, *Analytical Chemistry*, **1999**, 71, 4044-4049.
- Eugene Billiot, Stefan J. Thibodeaux, Javier Macossay, Shahab A. Shamsi, and Isiah M. Warner, “Chiral Separations Using Dipeptide Polymerized Surfactants: Effect of Amino Acid Order”, *Analytical Chemistry*, **1998**, 70, 1375-1381.
- Eugene Billiot, Jian Wang, and Isiah M. Warner, "Improved Chiral Separation Using Achiral Modifiers In Cyclodextrin Modified Capillary Zone Electrophoresis", *J.Chromatogr A.*, **1997**, 773, 321-329.

### Other significant publications

- Stefan J. Thibodeaux, Eugene Billiot and Isiah M. Warner “*Enantiomeric separations using poly(L-valine) and poly(L-leucine) surfactants; Investigation of steric factors near the chiral center*” *Journal of Chromatography A*, Volume 966, Issues 1-2, 9 **2002**, Pages 179-186
- F. Haddadian Billiot, E. J. Billiot, I. M. Warner “*Depth of Penetration of Binaphthyl Derivatives into the Micellar Core of Sodium Undecanoyl Leucyl-Leucinate Surfactants*” *J. Chrom. A*, **2002**, 950, 233.

### **Other significant publications (continued)**

- F. Haddadian Billiot, M. McCarroll, E. Billiot, J. Rugutt, I. M. Warner “Comparison of the Aggregation Behavior of 15 Polymeric and Monomeric Dipeptide Surfactants in Aqueous Solution” *Langmuir* **2002**; 18(8); 2993-2997.
- Billiot, F. H.; Billiot, E. J.; Warner, I. M. Comparison of monomeric and polymeric amino acid based surfactants for chiral separations. *J. Chromatogr., A* **2001**, 922(1-2), 329-338.
- Joseph K. Rugutt, Eugene J. Billiot, and Isiah M. Warner, “NMR Study of Interaction of Monomeric and Polymeric Chiral Surfactants with (R)- and (S)- 1-1'-binaphthyl-2-2'-diyl hydrogen phosphate”, *Langmuir*, **2000**, 3022-3029.

### **D) SYNERGISTIC ACTIVITIES (Awards and Patents)**

- 2001** Oak Ridge National Laboratory/Oak Ridge Associated Universities Historically Black Colleges and Universities and Minority Education Institutions Summer Faculty Research Program.
- 2001** Patent # US6270640: “Polymerized Oligopeptide-Surfactant Chiral Micelles”
- 1998** Louisiana State University Departmental of Chemistry Award for Superior Performance and Productivity in Chemical Research
- 1998** Phi Lambda Upsilon Robert V. Nauman Award for Excellence in Research
- 1998** I. M. Warner Award For Outstanding Performance

### **E) COLLABORATORS & OTHER AFFILIATIONS**

- (i) **Project Collaborators** : Fereshteh Billiot (Texas A&M University-Corpus Christi), Kirk Cammarata (Texas A&M University-Corpus Christi), Suzzette Chopin (Texas A&M University-Corpus Christi), Mark Greeley (Oak Ridge National Laboratory), Patrick Larkin (Texas A&M University-Corpus Christi), Patrick Louchouart (Texas A&M University-Corpus Christi), Joe Loter (Texas A&M University-Corpus Christi), Mark Morvant (Texas A&M University-Corpus Christi), Shahab Shamsi (Georgia State University), Isiah M. Warner (Louisiana State University)
- (ii) **Ph.D. Graduate Advisor for Eugene Billiot**  
Isiah M. Warner, Louisiana State University, 1994 – 1998  
**Summer Faculty Research Fellow working for**  
Mark Greeley, Ph.D., Oak Ridge National Laboratory, Summer 2001
- (iii) **Graduate Advisees/Co-Advisees (Thesis Track)**  
Arnold Mendez, Texas A&M University-Corpus Christi, 2001  
Mark Koekemoer, Texas A&M University-Corpus Christi, 2001

## **Budget Justification**

### **Year 1**

#### **Personnel**

Dr. Billiot will be Principal Investigator for the project. He will spend 25% time in the Fall and Spring, which the University will provide as cost sharing, directing the program. He is requesting 100% summer salary for two months where he will devote 100% of his time to this project. Support is also requested for five undergraduate students. The students will work 15 hours per week during Fall and Spring and 40 hours during the summer at a rate of \$6.00 per hour. Fringe benefits are calculated at a rate of 15.5% plus a fixed amount for insurance for full time personnel and 8.25 % for students.

#### **Travel**

Travel money is requested for the PI and two students to attend one conference the first year. The cost per person is \$1,500 -\$700 airfare, \$400 lodging, \$200 conference registration, and \$200 meals and other incidentals.

#### **Equipment**

\$4,500 is being requested the first year for the purchase of a tensiometer to perform surface tension measurements to determine the critical micelle concentration of the surfactants to be synthesized.

#### **Materials and Supplies**

A total of \$20,500 is being requested the first year of funding for chemicals such as molecular probes to be used for characterization of surfactants, reagents for synthesis, supplies for instruments such as cuvettes and lamps for the spectrofluorometer, CE supplies, NMR tubes, UV lamps to be used for polymerization and other miscellaneous supplies. More money for materials and supplies is being requested in the first year of funding due to extra costs associated start up.

#### **Indirect Costs**

The DHHS negotiated rate for the University is 49 % of salaries and wages.

## **Budget Justification**

### **Years 2-5**

#### **Personnel**

Dr. Billiot will be Principal Investigator for the project. He will spend 25% time in the Fall and Spring, which the University will provide as cost sharing, directing the program. He is requesting 100% summer salary for two months where he will devote 100% of his time to this project. Support is also requested for five undergraduate students. The students will work 15 hours per week during Fall and Spring and 40 hours during the summer at a rate of \$6.00 per hour. Fringe benefits are calculated at a rate of 15.5% plus a fixed amount for insurance for full time personnel and 8.25 % for students.

#### **Travel**

Travel money is requested for the PI and four students to attend one conference. The cost per person is \$1,500 -\$700 airfare, \$400 lodging, \$200 conference registration, and \$200 meals and other incidentals.

#### **Materials and Supplies**

A total of \$17,500 is being requested for chemicals such as molecular probes to be used for characterization of surfactants, reagents for synthesis, supplies for instruments such as cuvettes and lamps for the spectrofluorometer, CE supplies, NMR tubes, UV lamps to be used for polymerization and other miscellaneous supplies.

#### **Indirect Costs**

The DHHS negotiated rate for the University is 49 % of salaries and wages.

## FACILITIES, EQUIPMENT & OTHER RESOURCES

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**FACILITIES:** Identify the facilities to be used at each performance site listed and, as appropriate, indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Use "Other" to describe the facilities at any other performance sites listed and at sites for field studies. USE additional pages as necessary.

**Laboratory:** Adequate laboratory space (approximately 2,000 sq. ft.) and instrumentation are available including general laboratories as well as special instrumentation and computers in the research laboratories. Hoods, utilities, benches, and storage space are adequate for the proposed

**Clinical:**

**Animal:**

**Computer:** Adequate computer facilities are available. All of the instruments that will be used in this study have dedicated up-to-date computers with printing capability. In addition, all of the student workers have access to the computers in the PI's research labs.

**Office:** Adequate office space is available for the PI and the student researchers. The PI has a private office and the student researchers share office space in one of the five laboratories used by the students.

**Other:**

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**MAJOR EQUIPMENT:** List the most important items available for this project and, as appropriate identifying the location and pertinent capabilities of each.

- 1.Hewlett Packard Gas Chromatograph Mass Spectrometer GCD Plus System with autosampler
- 2.Hewlett Packard 8452A Photodiode Array Spectrometer
- 3.Perkin-Elmer Infrared Spectrophotometer Model 1310
- 4.Waters 600 High Performance Liquid Chromatography System with Millennium Chromatography software and the following detectors
  - a.Photodiode array detector Model 996

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**OTHER RESOURCES:** Provide any information describing the other resources available for the project. Identify support services such as consultant, secretarial, machine shop, and electronics shop, and the extent to which they will be available for the project. Include an explanation of any consortium/contractual arrangements with other organizations.

**Dr. Kevin Morris, one of the collaborators of the PI has a Bruker 300 MHz FT-NMR with a quatro nuclear (1H, 13C, 19F, 31P) probes and variable temperature capabilities.**

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## FACILITIES, EQUIPMENT & OTHER RESOURCES

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Continuation Page:

### **LABORATORY FACILITIES (continued):**

research.

### **COMPUTER FACILITIES (continued):**

### **MAJOR EQUIPMENT (continued):**

**b. Conductivity detector Model 490**

**c. Scanning Fluorescence detector Model 470**

**5. Waters Quanta 4000 Capillary Electrophoresis System**

**6. Hewlett Packard Capillary Electrophoresis System**

**7. SPEX Fluorolog-3 Spectrofluorometer with thermostatted 4-position sample holder and polarization accessory.**

Department of Physical and Life Sciences  
College of Science and Technology  
Texas A&M University – Corpus Christi

TO: CAREER Program  
FROM: Grady Price Blount, Ph.D., Chair  
DATE: 19 July 2002

re: Proposal by Eugene Billiot, Ph.D.

I am writing to provide my unqualified support for the career-development proposal submitted by Dr. Eugene Billiot to the Faculty Early Career Development Program.

Dr. Billiot is a tenure-track Assistant Professor of Chemistry in my department. He joined us in 2000.

I have read and I endorse this career-development plan. I attest that the PI's career-development plan is supported by and integrated into the educational and research goals of the department and the organization. I personally commit to the support and professional development of the PI.

I also verify the CAREER eligibility information for this PI.

Specific support elements for Dr. Billiot include:

- 1/4<sup>th</sup> research release time funded by the Office of the Provost.
- Provision of existing analytical laboratory space.
- Creation of a new instrumentation lab.
- Construction of two new Environmental Chemistry research lab facilities in a new building scheduled for an October 2002 ground-breaking.
- Assignment of new faculty mentoring task to PI as major component of required *Service* activities.
- Active participation in the NSF-funded Texas Collaborative for Excellence in Teacher Preparation.
- Recruitment and support programs for first-generation college students with potential for research success with the PI.

Dr. Billiot is one of our finest new faculty and I support his commitment to make Chemistry accessible to a broader audience of our student body. His teaching evaluations indicate that he has already become one of our most effective classroom instructors. In a large integrative department such as ours (we have 39 tenure-line faculty), Dr. Billiot's drive and talent stand out and leave little doubt that he will be one of our most outstanding academic leaders in the years ahead.



Grady Price Blount, [blount@tamucc.edu](mailto:blount@tamucc.edu)  
361-825-2358



# Carthage

July 15, 2002

The intent of this letter is to describe the planned collaborative efforts between Dr. Billiot and myself. The NMR experiments proposed by Dr. Billiot will be performed on the Bruker 300 MHz spectrometer at Carthage College. Routine proton and carbon spectra of the synthesized products will be collected to assess their purity and structure. In addition, two-dimensional NMR techniques such as COSY, TOCSY, NOESY, and ROESY will be used to carry out investigations of the surfactant conformation in monomer and micellar form. These same 2D-NMR techniques will also be used to characterize the interaction between analytes and surfactants. For example, NOESY and ROESY will allow us to determine which analyte-surfactant protons are in close spatial proximity, thus allowing us to investigate the mechanism of the analyte binding process.

Finally, Diffusion Ordered NMR Spectroscopy (DOSY) will be used to investigate the association equilibria that govern the analyte-surfactant interactions. In this 2D-NMR experiment, conventional chemical shift spectra are displayed in one dimension, while translational diffusion coefficients are displayed in the other. Therefore, in a surfactant-analyte mixture, diffusion coefficients can be determined for both components in a single experiment. If a second DOSY experiment is used to establish the analyte's free solution diffusion coefficient, then a two-site model of analyte binding can be used to calculate the mole fraction of bound compounds and the analyte-surfactant association constant. By establishing these association constants for surfactants with different headgroups, the fundamental thermodynamics that govern the analyte-surfactant interactions can be investigated.

Sincerely,

*Kevin F. Morris*

Kevin F. Morris  
Associate Professor of Chemistry  
Carthage College