

13:41:47

## OCA PAD INITIATION - PROJECT HEADER INFORMATION

05/28/93

Active

Project #: E-25-595                      Cost share #:                      Rev #: 0  
Center # : 10/11-6-P5096-3A0      Center shr #:                      OCA file #:  
Contract#: 5 T32 GM08433-03                      Mod #:                      Work type : INST  
Prime #:                      Document : GRANT  
Contract entity: GTRC  
Subprojects ? : N                      CFDA: 93.859  
Main project #:                      PE #:

Project unit:                      MECH ENGR                      Unit code: 02.010.126  
Project director(s):  
NEREM R M                      MECH ENGR                      (404)894-2768

Sponsor/division names: DHHS/PHS/NIH                      / NATL INSTITUTES OF HEALTH  
Sponsor/division codes: 108                      / 001

Award period:      930701      to      940630      (performance)      940930      (reports)

Sponsor amount	New this change	Total to date
Contract value	70,238.00	70,238.00
Funded	70,238.00	70,238.00
Cost sharing amount		0.00

Does subcontracting plan apply ? : N

Title: CELLULAR ENGINEERING TRAINING PROGRAM

## PROJECT ADMINISTRATION DATA

OCA contact: Kathleen R. Ehlinger                      894-4820

Sponsor technical contact	Sponsor issuing office
DR. CHRIS CARRICO, PROGRAM DIR. (301)594-7808	ANNETTE HANOPOLE, GRANT SPEC. (301)594-7819
NAT. INST. OF GEN. MED. SCI. WESTWOOD BLDG. 9000 ROCKVILLE PIKE BETHESDA, MD. 20892	NAT. INST. OF GEN. MED. SCI. WESTWOOD BLDG. 9000 ROCKVILLE PIKE BETHESDA, MD. 20892

Security class (U,C,S,TS) : U                      ONR resident rep. is ACO (Y/N): N  
Defense priority rating : N/A                      NIH supplemental sheet  
Equipment title vests with:      Sponsor                      GIT X  
NONE PROPOSED.

Administrative comments -

INITIATION OF PROJECT. TRAINING PROGRAM DOES NOT ALLOW FOR CARRY FORWARD OF  
EXPENDED FUNDS. NOTE: OH RATE IS 8% FOR THE FIVE YEARS OF THIS PROJECT.

16725  
52

GEORGIA INSTITUTE OF TECHNOLOGY  
OFFICE OF CONTRACT ADMINISTRATION

NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 10/19/94

Project No. E-25-595\_\_\_\_\_ Center No. 10/11-6-P5096-3A0\_  
Project Director NEREM R M\_\_\_\_\_ School/Lab MECH ENGR\_\_\_\_\_  
Sponsor DHHS/PHS/NIH/NATL INSTITUTES OF HEALTH\_\_\_\_\_  
Contract/Grant No. 5 T32 GM08433-03\_\_\_\_\_ Contract Entity GTRC  
Prime Contract No. \_\_\_\_\_  
Title CELLULAR ENGINEERING TRAINING PROGRAM\_\_\_\_\_  
Effective Completion Date 940630 (Performance) 940930 (Reports)

Closeout Actions Required:	Y/N	Date Submitted
Final Invoice or Copy of Final Invoice	N	_____
Final Report of Inventions and/or Subcontracts	N	_____
Government Property Inventory & Related Certificate	N	_____
Classified Material Certificate	N	_____
Release and Assignment	N	_____
Other _____	N	_____

Comments \_\_\_\_\_  
CONTINUED BY E-25-513 \_\_\_\_\_

Subproject Under Main Project No. \_\_\_\_\_

Continues Project No. E-25-581 \_\_\_\_\_

Distribution Required:

Project Director	Y
Administrative Network Representative	Y
GTRI Accounting/Grants and Contracts	Y
Procurement/Supply Services	Y
Research Property Management	Y
Research Security Services	N
Reports Coordinator (OCA)	Y
GTRC	Y
Project File	Y
Other _____	N
_____	N

SRC-3

DEPARTMENT OF HEALTH AND HUMAN SERVICES  
PUBLIC HEALTH SERVICE  
**TRAINING**  
**APPLICATION**  
**FOR CONTINUATION GRANT**

REVIEW GROUP	TYPE	ACTIVITY	GRANT NUMBER
	5	T32	GM08433-04

TOTAL PROJECT PERIOD  
From: **09/30/91** Through: **06/30/96**

REQUESTED BUDGET PERIOD  
From: **07/01/94** Through: **06/30/95**

To be verified by applicant. Check information in Items 1 through 6. If incorrect, furnish correct information in Item 13.

## 1. TITLE OF PROJECT

**CELLULAR ENGINEERING TRAINING PROGRAM**2a. PRINCIPAL INVESTIGATOR OR PROGRAM DIRECTOR  
(Name and address, street, city, state, zip code)

**NEREM, ROBERT M**  
**GEORGIA INST OF TECHNOLOGY**  
**CORNER OF PERST & CHERRY**  
**ATLANTA, GA 30332-0405**

## 4. APPLICANT ORGANIZATION (Name and address, street, city, state, zip code)

**GEORGIA TECH RESEARCH CORP**  
**ATLANTA, GA 30332**

## BITNET/INTERNET ADDRESS

5. ENTITY IDENTIFICATION NUMBER **1580603146A1**2b. DEPARTMENT, SERVICE, LABORATORY OR EQUIVALENT  
**SCH OF MECHANICAL ENGINEERING**

## 2c. MAJOR SUBDIVISION

## 6. TITLE AND ADDRESS OF ADMINISTRATIVE OFFICIAL

**CONTRACTING OFFICER**  
**GEORGIA TECH RESEARCH CORP**  
**OCA/PID RM-CRB**  
**GEORGIA INST OF TECHNOLOGY**  
**ATLANTA, GA 30332**

3. ORGANIZATIONAL COMPONENT TO RECEIVE CREDIT FOR  
BIOMEDICAL RESEARCH SUPPORT GRANT (See instructions)**N/A**

## BITNET/INTERNET ADDRESS

## Complete the following (see instructions)

## 7. HUMAN SUBJECTS

If "YES"  
exemption no. orIRB  
approval  
date4b. Assurance of  
compliance no.

☒ 7a. ☐  
NO YES

## 8. VERTEBRATE ANIMALS

If "YES,"  
IACUC approval date5b. Animal welfare  
assurance no.

☒ 8a. ☐  
NO YES

## 9. PERFORMANCE SITE(S) (Organizations and addresses)

Georgia Institute of Technology  
Atlanta, GA 30332

Emory University School of Medicine  
Atlanta, GA 30322

## 10. COSTS REQUESTED FOR NEXT BUDGET PERIOD

10a. DIRECT \$78,304 10b. TOTAL \$ 81,696

## 11. INVENTIONS AND PATENTS (See instructions)

☒ X NO ☐ YES If "YES," ☐ Previously reported ☐ Not previously reported

## TELEPHONE AND FAX INFORMATION

12a. PRINCIPAL INVESTIGATOR OR PROGRAM DIRECTOR (Item 2a)	AREA CODE	TELEPHONE NO. AND FAX NO.
Robert M. Nerem	404	894-2768 phone 894-2291 fax
12b. NAME OF ADMINISTRATIVE OFFICIAL (Item 6)		
Janis L. Goddard	404	894-4817 phone 894-6956 fax
12c. NAME AND TITLE OF OFFICIAL SIGNING FOR APPLICANT ORGANIZATION (Item 15)		
Janis L. Goddard Contracting Officer	404	894-4817 phone 894-6956 fax

## BITNET/INTERNET ADDRESS

## 13. USE THIS SPACE FOR CORRECTIONS TO ITEMS 1 THROUGH 6. INDICATE THE NUMBER(S) WHERE ANSWERS APPLY.

14. PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR ASSURANCE: I agree to accept responsibility for the scientific conduct of the project and to provide the required progress reports if a grant is awarded as a result of this application. Willful provision of false information is a criminal offense (U.S. Code, Title 18, Section 1001). I am aware that any false, fictitious, or fraudulent statement may, in addition to other remedies available to the Government, subject me to civil penalties under the Program Fraud Civil Remedies Act of 1986 (45 CFR 79).

SIGNATURE OF PERSON NAMED IN 2a  
(In ink. "Per" signature not acceptable.)

DATE

**12/2/93**

15. CERTIFICATION AND ACCEPTANCE: I certify that the statements herein are true and complete to the best of my knowledge, and accept the obligation to comply with the Public Health Service terms and conditions if a grant is awarded as the result of this application. A willfully false certification is a criminal offense (U.S. Code, Title 18, Section 1001). I am aware that any false, fictitious, or fraudulent statement may, in addition to other remedies available to the Government, subject me to civil penalties under the Program Fraud Civil Remedies Act of 1986 (45 CFR 79).

SIGNATURE OF PERSON NAMED IN 12c  
(In ink. "Per" signature not acceptable.)

DATE

**12/6/93**

NEXT BUDGET PERIOD Follow instructions carefully	FROM 94/07/01	THROUGH 95/06/30	GRANT NUMBER T32 GM08433
ITEMIZE DIRECT COSTS REQUESTED FOR NEXT BUDGET PERIOD			DOLLAR AMOUNT REQUESTED (Omit cents)
PREDOCTORAL STIPENDS			
			No. requested: 4 \$ 35,200
POSTDOCTORAL STIPENDS (Itemize)			
			No. requested: \$
OTHER STIPENDS (Specify)			
			No. requested: \$
TOTAL STIPENDS			\$ 35,200
TUITION, FEES, AND INSURANCE (Itemize)			
For each of four (4) students, tuition and fees per quarter are \$2,244; for four (4) students each enrolled four quarters per year, the total is \$35,904			
			\$ 35,904
TRAINEE TRAVEL (Describe)			
\$300 per student; to be used to support travel to scientific meetings			
			\$ 1,200
TRAINING RELATED EXPENSES			
\$1,500 per student; to be used to support research expenses, seminars, etc.			
			\$ 6,000
TOTAL DIRECT COSTS FOR NEXT BUDGET PERIOD (Also enter on Page 1, Item 10a)			\$ 78,304

**BUDGET JUSTIFICATION**

GRANT NUMBER

T32 GM08433

SUPPLEMENTAL INFORMATION REGARDING *ITEMS* IN THE PROPOSED BUDGET FOR THE NEXT PERIOD WHICH REQUIRE EXPLANATION OR JUSTIFICATION. (See instructions)

Trainee Tuition and Fees: On page 2 the amount of \$2,244 per quarter for each of four (4) students has been used. This is the non-resident amount for a full-time student and includes a matriculation fee of \$615, tuition of \$1,485, and other fees totaling \$144. For a resident, full-time student, the amount would be \$759 per quarter. This would include the matriculation fee of \$615 and \$144 in other fees, but no tuition since resident students are not charged tuition, only fees.

CURRENT BUDGET PERIOD	FROM July 1, 1993	THROUGH June 30, 1994	
The following pertains to your CURRENT PHS budget. This information may be used in determining the amount of support for the NEXT budget period.			
A. CURRENT BUDGET	TOTAL ESTIMATED EXPENDITURES AND OBLIGATIONS (1)	ESTIMATED UNOBLIGATED BALANCE (2)	EXPLAIN ANY SIGNIFICANT ESTIMATED UNOBLIGATED BALANCE IN COLUMN 2 (3)
TOTAL DIRECT COSTS	78,304		
INDIRECT COSTS (As provided)	3,392		
TOTALS →	81,696		

## **OTHER SUPPORT**

**Peggy R. Girard** - National Institutes of Health FIRST Award, HL-46490, "Shear Stress Effects on Endothelial Cell Focal Contacts," 2/1/92 - 1/31/96, \$350,000 (50% Effort).  
American Heart Association, Georgia Affiliate Award, "Cerebral Endothelial Cell Responses to Fluid Shear Stress: Possible Role in the Pathogenesis of Intracranial Aneurysms," 7/1/93 - 6/30/95, \$30,000 (10% Effort).

**Robert M. Nerem** - National Science Foundation Grant BCS-9111761, "Reconstitution of a Blood Vessel In Culture," 9/1/91 - 2/28/95, \$543,740 (10% Effort).

National Institutes of Health Grant GM08433, a Training Grant entitled "Cellular Engineering," 9/26/91 - 6/30/96, \$339,208 (5% Effort).

Emory/Georgia Tech Biomedical Technology Research Center Project, "Center of Excellence in Cellular Imaging," 7/1/92 - 6/30/94, \$100,000 (5% Effort).

National Institutes of Health Program Project, HL-48667, subcontract from Emory University, "Initiating Events in Vascular Lesion Formation," Project 2, 9/30/92 - 9/29/97, \$300,000 (5% Effort).

National Institutes of Health Specialized Center, HL-48482, subcontract from Emory University, "Comprehensive Sickle Cell Center," Project 2, 4/1/93 - 3/31/98, \$460,831 (10% Effort).

National Institutes of Health Program Project, HL-26890, subcontract from University of Texas Health Science Center at San Antonio, "Cellular Mechanisms in Atherogenesis," 7/1/88 - 6/30/94, \$500,000 (5% Effort).

**Athanassios Sambanis** - Whitaker Foundation Grant, "Development and Characterization of a Prototype for NMR Studies of Mammalian Cells," 4/1/91 - 3/31/94, \$179,810 (10% Effort).

National Science Foundation (SUCCEED Program), "Development of Course 'Bioengineering Applications in Biology,'" 10/93 - 2/95, \$41,848 (10% Effort).

National Institutes of Health, "Cellular Engineering Training Program," 9/91 - 6/96, \$339,208 (5% Effort).

**Timothy M. Wick** - National Institutes of Health Grant, "Sickle Erythrocyte Adhesion to Activated Endothelium," 7/25/91 - 6/30/96, \$300,000 (20% Effort).

Whitaker Foundation Grant, "Endothelial Cell Activation and Blood Cell Adhesion in Atherosclerosis," 7/1/91 - 6/30/94, \$150,000 (25% Effort).

National Institutes of Health Specialized Center, HL-48482, subcontract from Emory University, "Comprehensive Sickle Cell Center," Project 1, 4/1/93 - 3/31/98, \$375,000 (20% Effort).

National Institutes of Health Specialized Center, HL-48482, subcontract from Emory University, "Comprehensive Sickle Cell Center," Project 2, 4/1/93 - 3/31/98, \$460,000 (10% Effort).

The Whitaker Foundation, "Endothelial Cell Activation and Blood Cell Adhesion in Atherosclerosis," 7/1/91 - 6/30/94, \$179,999 (15% Effort).

National Institutes of Health Grant #T32GM08433-02, "Cellular Engineering Training Program," 9/26/91 - 8/31/95, \$339,208 (0% Effort).

National Institutes of Health, "Mechanism of Sickle Erythrocyte/ Endothelial Adherence," 9/25/92 - 6/30/97, \$349,992 (50% Effort).

**Cheng Zhu - Whitaker Foundation Grant, "Mechanism of Melanoma Cell-Endothelial Cell Adhesion," 7/1/92 - 6/30/95, \$161,2088 (2% Effort).**  
**National Science Foundation Grant, RCS-7210684, "Modeling of Transient Processes in Cell Adhesion," 9/1/92 - 2/28/95, \$68,796 (17% Effort).**  
**Emory/Georgia Tech Biomedical Technology Research Center grant, "Regulation of Cell Adhesion in Kaposi's Sarcoma," 7/1/93 - 6/30/94, \$30,000 (0% Effort).**  
**National Science Foundation Grant No> BCS-9350370, "Presidential Faculty Fellowship: Cell Adhesion and Cell Locomotion," 9/1/93 - 2/28/99, \$460,453 (17% Effort).**

**Progress Report Summary**

**T32 GM08433**

**Principal Investigator: Robert M. Nerem**

**Period Covered by Report**

**Applicant Organization: Georgia Institute of Technology**

**July 1, 1992-June 30, 1993**

**Title of Project: Cellular Engineering Training Program**

1. This Cellular Engineering Training Program has the objective of educating doctoral students in the application of engineering concepts, methods, and practices to problems in which the cell and cellular phenomena are the central element. The focus is biotechnology including both bioprocess engineering and tissue engineering, the latter being the development of biological substitutes in order to repair, maintain, and/or enhance function. The essence of tissue engineering is the use of living cells, together with extracellular matrix as well as other components, to make implantable tissues and organs so as to restore and/or improve function.

This training grant was funded at the end of September 1991, and thus we are now in our third year. Four students are now appointed as will be discussed below in item 2; however, during the period covered by the report, only three students were supported by this grant. Their research and the publications/presentations resulting from this research will be discussed as part of items 3 and 4. We believe that the training grant has allowed us to more aggressively recruit women and underrepresented minorities into our overall program. Of our three appointments during the period covered by this report, two are women, with one of these being an underrepresented minority. Currently, with four students appointed, three are women, with one a minority. There are two new students, Mr. Scott Chesla and Miss Linda Greer, and Mr. Piper has gone off the grant effective September of this year.

Students appointed to the training grant participate in a variety of on-going activities including the weekly meeting of the Mammalian Cell Culture Laboratory. This series includes both the presentation of progress reports by students on their research and an every third week journal club. As part of the aggressive recruiting of the School of Chemical Engineering and the School of Mechanical Engineering, the two primary participating academic units in this training program, we have 20 students participating in the research program in the Mammalian



Cell Culture Laboratory, i.e. in our cellular engineering program. Of these, 12 are U.S. citizens, and of these 12, 8 are women with two of these being minorities. One of the men is also a minority. Of the 8 non-U.S. citizens, five are from Europe and three are from Asia, with two of the eight being women. Thus, 50 percent of the total number of students are women and 15 percent are underrepresented minorities.

As will be discussed under item 5, during the past 12 months external research dollars for the cellular engineering group have increased significantly. All five of our core faculty have grant support. One of these, Dr. Cheng Zhu, was awarded the 1992 Y.C. Fung Young Investigator Award by the American Society of Mechanical Engineers and has just been awarded a Presidential Faculty Fellowship by the White House. Another, Dr. Nerem, the director of this training program, is the chair of the 1994 Keystone Tissue Engineering Symposium.

Finally, as will be discussed under item 6, a major award for cell biology/cell culture equipment has been made to Georgia Tech by the State of Georgia. Furthermore, Georgia Tech, in partnership with Emory, received one of three awards from a private foundation. This also will be discussed under item 6.

2. The three appointments to this training grant during the period covered by this report are listed in Table I. Two of these, Ms. Jill J. Dyken and Mr. James W. Piper, were appointed in 1991, and the third student, Ms. Marena Gatewood Brown, was appointed July 1, 1992. As noted earlier, two of these three appointments are women, one of whom is black as noted in Table II. Ms. Dyken entered graduate school with a B.S. in Chemical Engineering in September 1989 and has already passed her Ph.D. qualifiers. Mr. Piper entered graduate school in September 1990 with a B.S. in Mechanical Engineering. They both were initially appointed for the period November 1, 1991 through June 30, 1992 and were continued into the second year of the training grant. The third student is Ms. Marena Brown who entered our program summer quarter 1992 with an M.S. degree, followed by one year as an Instructor at Morris Brown College teaching chemistry and physics.
3. Jill Dyken's dissertation project is entitled "Protein Secretion From Endocrine Animal Cell Cultures: Effects of Chemical Stress and Growth Mode." Endocrine cells have the ability to release biologically active

hormones in a regulated fashion. In order to optimize designs of industrial and medical systems exploiting this property, it is necessary to study how different culturing environments, inherent in those systems, affect the protein trafficking events leading to secretion of bioactive hormones. The goal of this research is to study how protein processing and secretion are affected by elevated levels of the metabolite ammonium and by culturing cells in different morphologies. She previously showed that ammonium had a strong, selective inhibitory effect on the regulated pathway of secretion in two endocrine cell lines, BTC3 and AtT-20. In the past year, she has been able to clarify this inhibition. She discharged cells and then evaluated the effect of ammonium on the time course of accumulation of processed insulin, measured by HPLC. Using this method, she found that the recharging of insulin was almost identical to that of insulin-related peptides, which were measured with a more quantitative, but less insulin-specific, assay. Current research in this area includes examining the effect of ammonium on indicators of cellular metabolism and developing a comprehensive, quantitative model that describes the effect of ammonium on endocrine cells. In other research, preliminary experiments had shown that AtT-20 cells cultured in aggregates (spheroids) showed a similar ability to release protein from the regulated pathway as monolayer cultures. While this result has not yet been reproduced, experiments performed on BTC3 cells reproducibly showed identical secretion patterns between monolayers and spheroids.

Ms. Dyken has completed all of her courses as reported last year. It is expected that she will graduate with her Ph.D. in 1994 and take a position in industry.

The project on which Mr. James W. Piper has been working is the *in vitro* study of the functional activities of the cell adhesion receptor, E-selectin. The objective is to elucidate the role of E-selectin on the adhesion of tumor cells to vascular endothelial cells. The research involves a collaboration with Dr. Robert A. Swerlick in the Department of Dermatology, Emory University School of Medicine. The ability of E-selectin to mediate tumor cell adhesion was quantified using a centrifugation technique. The extracellular fragment of recombinant E-selectin was shown to be functionally active as an adhesion receptor. The adhesion function of this molecule was found to be independent of temperature and metabolic activities. A protocol for using a simplified

system to examine binding of cells via the E-Selectin molecule was developed. The protocol anchors a LEC-EGF fragment of the E-Selectin molecule to the wells of a plastic 96-well plate. These anchored fragments possess the binding functionality and specificity of the complete E-Selectin molecule. With this system, the site density of E-Selectin, magnitude of separation force, and duration of separation force can be controlled. Binding experiments between tumor cell lines (Colo-205 and HL-60) and E-Selectin coated plastic plates were completed using a centrifugation technique. Results show the qualitative relationship among site density of adhesion molecules, the magnitude of the imposed separation force, the duration of the separation force and the binding of the tumor cells.

In addition to what was reported last year, Mr. Piper has now completed the following courses:

CHEM6502     Biochemistry 2  
MATH4347     Partial Differential Equations I  
MATH4347     Partial Differential Equations II  
PUBPOL6410   Science, Technology, and Public Policy

Mr. Piper also passed his Ph.D. qualifiers during the past year.

Marena Brown's thesis work is aimed at determining the role of sickle erythrocyte membrane components on the upregulation of endothelial cell adhesion molecule expression leading to increased adhesion of sickle erythrocytes to the endothelium. This research will contribute to a further understanding of the mechanisms of blood vessel damage and blood vessel occlusion associated with sickle cell disease. To date she has demonstrated that incubation of cultured endothelial cells with sickle (and not normal) red cells upregulates endothelial cell ICAM-1, VCAM-1, and ELAM-1 expression. All initial work has been performed using human umbilical vein endothelial cells (HUVEC). Because of their availability and relatively low cost, the details of all procedures will first be worked out using HUVEC and then extended to human aortic (arterial) endothelial cells. To date, the response of HUVEC to washed sickle and normal blood samples has been determined. Upon incubation with each blood sample, sickle samples induce higher levels of cell adhesion molecule expression. The response is both time dependent and concentration dependent. Considerable effort has been put into

determining why the sickle sample causes a greater response. Since clinical intervention is a long-term objective of most work performed in this lab, to know which component initiates the endothelial response is very important. Currently three blood components are under consideration: reticulocytes (young red blood cells which make up a greater percentage of a sickle blood sample), white blood cells (since sickle patients are anemic, they tend to have higher white cell counts), or sickle erythrocytes in general (due to their modified membrane surface). The type of and approach to intervention will be greatly influenced by the component causing the endothelial response. She is also investigating whether direct endothelial contact is necessary for the inflammatory response to be initiated.

Since last year Ms. Brown has completed the following additional courses:

CHEM6501	Biochemistry I
CHEM6503	Biochemistry III
CHEM6521	Structure of Proteins and Nucleic Acids
CHEM6211	Advanced Inorganic Chemistry I

4. Listed below are the publications/presentations representing the research conducted by students appointed to this training grant.

Dyken, J.J., Papas, K.K., Vachtsevanos, J., and Sambanis, A. Endocrine Animal Cell Cultures in Bioprocessing and Tissue Engineering. Cell Culture Engineering III, Palm Coast, FL: February 1992.

Dyken, J.J. and Sambanis, A. Protein Secretion From Endocrine Animal Cells: Effects of Chemical Stress and Culturing Mode. 1992 Graduate Student Symposium Poster Session, Georgia Institute of Technology, School of Chemical Engineering: May 1992.

Dyken, J.J. and Sambanis, A. Protein Secretion in Endocrine Animal Cell Cultures: Effects of Chemical Stress and Culturing Mode. 1992 AIChE National Meeting, Miami Beach, FL, November 1992.

Dyken, J.J. and Sambanis, A. Characterization of Hormone Processing and Secretion in Endocrine Cells Cultured in the Absence and Presence of Metabolic Byproducts. 1993 AIChE National Meeting, St. Louis, MO, November 1993.

Dyken, J.J. and Sambanis, A. Ammonium Selective Inhibits the Regulated Pathway of Protein Secretion in Two Endocrine Cell Lines. *Enzyme and Microbial Technology*, 1993 (in press).

Brown, M.J., Eckman, R. and Wick, T.M. Sick Erythrocytes Promote Increased Expression of Cell Adhesion Molecules on Human Umbilical Vein Endothelial Cells. 1993 Annual Meeting of the American Institute of Chemical Engineers, St. Louis, MO, November 1993.

Wick, T.M., Brown, M.D., and Eckman, J.R. Sick Red Blood Cells Induce Expression of Cell Adhesion Molecules on Human Umbilical Vein Endothelial Cells. 1993 Annual Meeting of the American Society of Hematology, St. Louis, MO, December 1993.

Gatewood, M., Eckman, R. and Wick, T.M. Sick Erythrocytes Stimulate Upregulation of Endothelial Cell VCAM-1, ELAM-1, and ICAM-1. In preparation.

5. External research support for our overall cellular engineering program is listed in the table provided earlier which is entitled Other Support. However, two major awards have been received in which the Georgia Tech cellular engineering group is an active participant. One of these is the award to Emory University by NHLBI of a Comprehensive Sick Cell Center with Dr. James Eckman, one of our faculty associates, as principal investigator and center director. Two of the seven research projects which are part of this proposal are Georgia Tech projects, with one headed by Dr. Timothy Wick and one headed by Dr. Nerem. The other award, also by NHLBI to Emory University, is a Vascular Biology in Medicine Program Project. This is headed by Dr. Wayne Alexander, also a faculty associate, with Dr. Nerem having a strong involvement with one of the four research projects.

In addition, it should be noted that both Jill Dyken and James Piper receive supplements to their trainee stipends. For Ms. Dyken this includes annually a \$4,000 Presidential Fellowship from Georgia Tech,

a \$4,000 Dupont Fellowship, and \$3,000 from the Emory/Georgia Tech Biomedical Technology Research Center. For Mr. Piper this includes annually a \$4,000 Presidential Fellowship and \$2,700 from the School of Mechanical Engineering. Ms. Brown also receives a supplement of \$5,000 annually to bring her total stipend up to the standard rate for a chemical engineering graduate student.

6. Two recent awards are significantly impacting our cellular engineering program at Georgia Tech. One of these is the award of a \$500,000 grant for scientific equipment from the State of Georgia through a biotechnology initiative developed by the Georgia Research Alliance, the consortia of research universities within the state. The new equipment and additional space has significantly enhanced our program.

The second effort was a Biomedical Engineering Development Award from the Whitaker Foundation. These awards are for the enhancement of graduate programs, and the Georgia Tech proposal, which was submitted in partnership with Emory, was focused on the expansion of our cellular engineering program. In total there were 58 preliminary proposals from universities all over the U.S., and of these, 14 institutions, including Georgia Tech, were selected to submit full applications. Five of these 14 were selected to be site visited, and of these, three received awards. Georgia Tech is one of these, and our selection reinforces for us our belief in the quality of the cellular engineering program we are building and the direction our recruiting efforts are taking. Over the next four years we will add six new faculty in cellular engineering at Georgia Tech and two new faculty at Emory.

**TABLE I—  
SUMMARY OF TRAINEES SUPPORTED DURING  
CURRENT BUDGET PERIOD**

**GRANT NUMBER**

T32 GM08433

Name Marena Brown Social Security No. 498-80-4556 Pre/Post Pre-Doctoral  
Degrees Held Date of Init. Date of Total Months  
at Entry M.S. Appointment July 1, 1992 Termination -- of Appt. --  
Additional Remarks

Name Jill J. Dyken Social Security No. 316-56-4536 Pre/Post Pre-Doctoral  
Degrees Held Date of Init. Date of Total Months  
at Entry B.S. Appointment Nov. 1, 1991 Termination -- of Appt. --  
Additional Remarks

Name James Piper Social Security No. 415-90-7944 Pre/Post Pre-Doctoral  
Degrees Held Date of Init. Date of Total Months  
at Entry B.S. Appointment Nov. 1, 1991 Termination -- of Appt. --  
Additional Remarks

Name \_\_\_\_\_ Social Security No. \_\_\_\_\_ Pre/Post \_\_\_\_\_  
Degrees Held Date of Init. Date of Total Months  
at Entry \_\_\_\_\_ Appointment \_\_\_\_\_ Termination \_\_\_\_\_ of Appt. \_\_\_\_\_  
Additional Remarks

Name \_\_\_\_\_ Social Security No. \_\_\_\_\_ Pre/Post \_\_\_\_\_  
Degrees Held Date of Init. Date of Total Months  
at Entry \_\_\_\_\_ Appointment \_\_\_\_\_ Termination \_\_\_\_\_ of Appt. \_\_\_\_\_  
Additional Remarks

Name \_\_\_\_\_ Social Security No. \_\_\_\_\_ Pre/Post \_\_\_\_\_  
Degrees Held Date of Init. Date of Total Months  
at Entry \_\_\_\_\_ Appointment \_\_\_\_\_ Termination \_\_\_\_\_ of Appt. \_\_\_\_\_  
Additional Remarks

Name \_\_\_\_\_ Social Security No. \_\_\_\_\_ Pre/Post \_\_\_\_\_  
Degrees Held Date of Init. Date of Total Months  
at Entry \_\_\_\_\_ Appointment \_\_\_\_\_ Termination \_\_\_\_\_ of Appt. \_\_\_\_\_  
Additional Remarks

<b>TABLE II— DISTRIBUTION OF TRAINEES SUPPORTED DURING THE REPORTING PERIOD ACCORDING TO CATEGORY (See page 3 for definitions)</b>					GRANT NUMBER
					T32 GM08433
American Indian or Alaskan Native	Asian or Pacific Islander	Black	Hispanic	White	TOTAL
		1		2	3



GRANT NUMBER
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T32 GM08433

**All Personnel for the Current Budget Period  
and Any Planned Changes in Personnel for the Next Budget Period**

Use two sections. In the first section list *All Current Personnel*. In the second section list *Planned Personnel Changes*.

Name	Degree(s)	SSN	Role on Project (e.g., PI, Res. Assoc.)	Date of Birth (MM/DD/YY)	Annual % Effort
Robert M. Nerem	Ph.D.	334-30-6030	Program Dir.	7/20/37	15
Timothy M. Wick	Ph.D.	508-94-2891	Ass't Director	7/9/61	15
Peggy R. Girard	Ph.D.	118-48-1453	Preceptor	4/10/55	5
Athanassios Sambanis	Ph.D.	474-92-0371	Preceptor	10/9/56	20
Cheng Zhu	Ph.D.	055-70-4753	Preceptor	2/10/57	20

Provide the number of subjects enrolled in the study **to date** according to the following categories. (See Page 8 for definitions.)

	American Indian or Alaskan Native	Asian or Pacific Islander	Black, not of Hispanic Origin	Hispanic	White, not of Hispanic Origin	Other or Unknown	TOTAL
Female	NOT APPLICABLE						
Male							
Unknown							
TOTAL							

