

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

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---

**PI/PD Name:** Catherine M Mader

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

**Race:**  
(Select one or more)  
 American Indian or Alaska Native  
 Asian  
 Black or African American  
 Native Hawaiian or Other Pacific Islander  
 White

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

**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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**PI/PD Name:** Herbert L Dershem

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

**Race:**  
(Select one or more)  
 American Indian or Alaska Native  
 Asian  
 Black or African American  
 Native Hawaiian or Other Pacific Islander  
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**Disability Status:**  
(Select one or more)  
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**PI/PD Name:** Moses Lee

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

**Race:**  
(Select one or more)  American Indian or Alaska Native  
 Asian  
 Black or African American  
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(Select one or more)  Hearing Impairment  
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## 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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## CERTIFICATION PAGE

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

By signing and submitting this proposal, the Authorized Organizational Representative or Individual Applicant 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), nondiscrimination, and flood hazard insurance (when applicable) as set forth in the NSF Proposal & Award Policies & Procedures Guide, Part I: the Grant Proposal Guide (GPG) (NSF 09-29). 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).

### Conflict of Interest Certification

In addition, if the applicant institution employs more than fifty persons, by electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative 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 the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.A; 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 Exhibit II-3 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 Exhibit II-4 of the Grant Proposal Guide.

### Certification Regarding Lobbying

The following 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.

### Certification Regarding Nondiscrimination

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative is providing the Certification Regarding Nondiscrimination contained in Exhibit II-6 of the Grant Proposal Guide.

### Certification Regarding Flood Hazard Insurance

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:

- (1) community in which that area is located participates in the national flood insurance program; and
- (2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:

- (1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and
- (2) for other NSF Grants when more than \$25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE		SIGNATURE	DATE
NAME <b>Tracey Nally</b>		<b>Electronic Signature</b>	<b>Sep 29 2009 4:00PM</b>
TELEPHONE NUMBER <b>616-395-7316</b>	ELECTRONIC MAIL ADDRESS <b>Nally@hope.edu</b>	FAX NUMBER <b>616-395-7111</b>	

\* EAGER - EARly-concept Grants for Exploratory Research

\*\* RAPID - Grants for Rapid Response Research

**NATIONAL SCIENCE FOUNDATION**  
**Division of Undergraduate Education**

**NSF FORM 1295: PROJECT DATA FORM**

The instructions and codes to be used in completing this form are provided in Appendix II.

1. **Program-track** to which the Proposal is submitted: **STEP-Type 1A** \_\_\_\_\_
2. Name of **Principal Investigator/Project Director** (as shown on the Cover Sheet):  
**Mader, Catherine** \_\_\_\_\_
3. Name of submitting **Institution** (as shown on Cover Sheet):  
**Hope College** \_\_\_\_\_
4. **Other Institutions** involved in the project's operation:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Project Data:**

- A. Major Discipline Code: **99** \_\_\_\_\_
- B. Academic Focus Level of Project: **LO** \_\_\_\_\_
- C. Highest Degree Code: **B** \_\_\_\_\_
- D. Category Code: **--** \_\_\_\_\_
- E. Business/Industry Participation Code: **NA** \_\_\_\_\_
- F. Audience Code: **WM** \_\_\_\_\_
- G. Institution Code: **PRIV** \_\_\_\_\_
- H. Strategic Area Code: \_\_\_\_\_
- I. Project Features: **2** \_\_\_\_\_

Estimated number in each of the following categories to be directly affected by the activities of the project during its operation:

- J. Undergraduate Students: **200** \_\_\_\_\_
- K. Pre-college Students: **70** \_\_\_\_\_
- L. College Faculty: **70** \_\_\_\_\_
- M. Pre-college Teachers: **10** \_\_\_\_\_
- N. Graduate Students: **0** \_\_\_\_\_

## **Creating the Hope STEM Scholars Program**

The proposal seeks funding to create the Hope College STEM Scholars program. The objectives of the Hope STEM Scholars program are to:

1. double the number of local high school students applying to Hope College with intentions to major in STEM fields,
2. increase the diversity of Hope STEM major population by doubling the number of underrepresented students from local high schools that attend Hope College and major in STEM fields,
3. increase the number of targeted students who graduate from Hope College with a major in a STEM discipline.

Fourteen new students in each of the five years of the project will be recruited from local high schools. These schools have very diverse student bodies and very well-qualified students. However, currently very few students from these schools apply to or attend Hope College and major in STEM fields. The STEM Scholars program brings together several existing Hope programs that will be the source of the applicant pool for the Hope STEM Scholars program, as well as several new programs that will provide additional support and enable high retention of program participants. Specifically, the Hope STEM Scholars program will include:

1. Research and research-like experiences for students during their junior year in high school and the subsequent summer.
2. Student support and mentoring during their senior year in high school.
3. Research experiences for students after graduation from high school.
4. First-year experiences for STEM Scholars during the academic year to build community.
5. Research experiences for STEM Scholars during the summer following their Freshman year at Hope.
6. Continual support in research and educational activities during their remaining three years in college to help develop professional skills.

### **Broader Impacts**

Currently, ~120 Hope College students earn bachelors degrees in STEM fields each year. By increasing this number by 12% per year, 14 young adults with strong STEM educations will be able to pursue post-graduate degrees or directly enter the workforce. A significant number of Hope STEM alumni pursue post-graduate studies in science and engineering fields.

In addition, by building a strong connection between Hope College and the local high school graduates, the educators in both programs will also build stronger connections. Administrators and teachers at local high schools are very interested in bringing research experiences into their classrooms, and the Hope STEM Scholars and their mentors will serve as great role models and potential mentors for the high school students. Thus while only 14 STEM majors will be directly funded by this proposed project each year, a significantly larger number of high school science students and teachers will be affected.

### **Intellectual Merit**

The proposed project will bring diverse, young and enthusiastic researchers together with experienced research teams at Hope College. Most of these research teams are engaged in programs that are supported by grants from external sources. These grants were awarded because the scientific studies were deemed significant and worthwhile. Thus the STEM Scholars will be engaged in generating new knowledge and will experience doing science first-hand at an early stage in their career. Based on assessment of similar programs that engage Hope students in research, they will not only build skills, but confidence in their ability to do science. They will begin to self-identify as scientists. Thus this program will not only advance the scientific knowledge in the fields studied by the STEM Scholars, it will advance the growth of the STEM Scholars as scientists.



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For font size and page formatting specifications, see GPG section II.B.2.

	<b>Total No. of Pages</b>	<b>Page No.* (Optional)*</b>
Cover Sheet for Proposal to the National Science Foundation		
Project Summary (not to exceed 1 page)	1	_____
Table of Contents	1	_____
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	_____
References Cited	1	_____
Biographical Sketches (Not to exceed 2 pages each)	6	_____
Budget (Plus up to 3 pages of budget justification)	12	_____
Current and Pending Support	4	_____
Facilities, Equipment and Other Resources	2	_____
Special Information/Supplementary Documentation	0	_____
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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## Hope STEM Scholars Program

### A. Quality STEM major programs at Hope College

The Division of Natural and Applied Sciences at Hope includes the departments of Biology, Chemistry, Computer Science, Engineering, Geological & Environmental Sciences, Mathematics, Nursing, and Physics and totals over 60 FTE faculty members. Hope College has a long-standing commitment to provide students opportunities to learn cutting-edge science in coherent and rigorous laboratory courses that stress hands-on, research-based modes of learning, and to work in an interdisciplinary and collaborative manner with faculty in research. The Division of Natural Sciences at Hope is recognized by Project Kaleidoscope as a "Program that Works" and as a model for other institutions, and is one of only 10 liberal arts institutions to be recognized by the NSF with an Award for the Integration of Research and Education. Additionally, the undergraduate research program at Hope has been identified in *U.S. News & World Report* as among the leading programs in the nation consistently for each of the last 5 years (ranked 4<sup>th</sup> among all institutions in 2003). A 2009 American Enterprise Institute for Public Policy Research report found that Hope shared the top spot in Michigan for highest baccalaureate college graduation rate (78%).[1]

The mission of the program in science and mathematics at Hope mirrors that of the college to provide an **innovative curriculum**, which intertwines **student learning** and **faculty development**. The division operates under the guiding principle that undergraduate research is an essential component of good teaching and effective learning. The collegial culture within the Division of Natural Sciences is the key ingredient in sustaining an intellectually vital learning community for faculty and students. In the past five years, Hope science faculty/administrators received awards totaling greater than \$2,400,000 annually in new resources from extramural sources to support research, educational and outreach programs. A recent report by Research Crossroads found that Hope held more funding from the National Science Foundation and the National Institutes of Health than any other liberal arts college in Michigan. Included among current awards are 5 separate NSF-REU site awards to support undergraduate research.[2]

Faculty and students sustain vitality by engaging in research. Hope College ranks 4<sup>th</sup> of all liberal arts institutions for numbers of faculty research publications and 14<sup>th</sup> overall for highest impact of those publications as measured by the Science Citation Index. Since 1990 over 300 undergraduate students have co-authored research publications with faculty.

An unusually high number of students (~40%) enter Hope with an interest in science and mathematics. A large fraction of these students are interested in pursuing careers in a health field (including nursing, which is a degree granting program at Hope). During their time at Hope, students are integrated into a supportive community of learners in an environment rich in research-based learning opportunities. For example, each summer over 140 undergraduates conduct research with faculty. Approximately 33% of seniors graduate with a degree in science or mathematics. Of these, ~30% enter graduate school. About 35% of our science-mathematics graduates seek to enter professional school. The 10-year acceptance rate for these students is 71%, and it is 90% for students who engage in research while at Hope. The remaining students enter the workforce directly upon graduation, with many entering the teaching profession as K-12 educators.

While the numbers of students interested in STEM fields enrolled at Hope College is reasonably large, the STEM student body is not very diverse, both in terms of race and ethnicity and in terms of economic status. The college has several initiatives designed to increase the diversity of our student body and faculty in order to broaden perspectives of all Hope community members involved the educational endeavor. This will not only improve the research and education programs at Hope, but will better prepare our students to participate in the global STEM community.

**Table 1: Graduating Majors by Year**

Department	2004	2005	2006	2007	2008	Ave.	% female
Biology	31	34	30	31	54	36.0	57.2%
Chemistry	27	32	29	36	46	34.0	45.9%
Computer Science	14	9	7	7	9	9.2	17.4%
Engineering	8	5	14	12	22	12.2	34.4%
Geology & Environmental sciences	5	2	3	7	7	4.8	62.5%
Mathematics	15	11	17	19	19	16.2	39.5%
Physics	3	4	7	5	2	4.2	42.9%
Total STEM graduates	103	97	107	117	159	116.6	
Total Graduating Class	620	647	659	716	717	671.8	

Currently, the total enrollment at Hope College is ~3200 FTE students. The total number of bachelors degrees conferred each year is ~700. Of this, approximately 20% of the degrees are awarded in the traditional STEM fields (see Table 1).

The current overall retention rates at the college are quite high (Table 2). Our long-running average indicates that 78% of our incoming students earn bachelors degrees within 6 years of entering the college. Retention within departments or major fields is a bit more difficult to quantify since the majority of Hope students wait to declare majors until they have reached the midpoint of their sophomore year. Nearly 40% of the incoming students indicate an interest in careers STEM fields. However, a significant fraction of these students express interest in health professions and two or three other potential major fields outside of the traditional STEM programs. Thus the fact that only 20% of the bachelors degrees awarded at Hope are in STEM fields is not indicative of a 50% retention rate within the STEM discipline due to over estimation of incoming interest in STEM fields. Nationally, only 23% of all undergraduates initially choose to pursue STEM degrees and approximately 40% of those students actually obtain STEM degrees.[3]

Thus not only do Hope STEM majors receive excellent educations that involve significant hands-on research and applied experiences, but also a significant number of those student complete their degrees in a timely manner and proceed on to become members of the STEM workforce.

**Table 2: Hope College Cumulative Retention Rates: cohort beginning Fall 2002**

At end of Year 1	At End of Year 2	At End of Year 3	At End of Year 4	At End of Year 5	At End of Year 6
87.4%	79.3%	77.9%	74.6%	73.8%	73.2%

## B. Hope STEM Scholars Program Objectives and Goals

While Hope’s recruitment and retention efforts are good, they could be better. Thus this proposal seeks funding to create the Hope STEM Scholars program. This program will improve recruitment efforts locally, with a goal of improving diversity within our STEM majors. It will also improve retention through strategic initiatives to address issues that have been shown to influence college students’ decisions to remain in STEM majors or change to non-STEM majors at colleges and universities in west Michigan.[4]

Because of the close connections among all departments in the Division of Natural and Applied Sciences at Hope College, the Hope STEM Scholars program will not focus on any single STEM discipline at Hope, but rather will seek to increase enrollments within the division as a whole. Clearly, several departments have smaller enrollments than others and would be impacted more greatly by

small increases, but the overall program will strive to improve recruitment and retention across all fields. In reality, a future member of the STEM workforce will not only work with colleagues that are from diverse social and economic backgrounds, but also from diverse disciplines. They will be asked to work in interdisciplinary and multidisciplinary teams to address complex problems. Thus by providing opportunities in all fields, but emphasizing the interconnected nature of doing STEM, and building community amongst all Scholars, graduates of the program will be well prepared to work in a very diverse, global, interdisciplinary STEM community.

The Hope STEM Scholars program will not only address increasing the number of majors in all STEM fields, it will also address preparing students to work in teams consisting of individuals from diverse backgrounds. This will be achieved by building a STEM Scholar program that attracts a more diverse group of STEM majors to Hope College than is presently in place, enables these students to earn their degrees and then join the STEM workforce.

**The objectives of the Hope STEM Scholars program are to:**

1. double the number of local high school students applying to Hope College with intentions to major in STEM fields,
2. increase the diversity of Hope STEM major population by doubling the number of underrepresented students from local high schools that attend Hope College and major in STEM fields,
3. increase the number of targeted students who graduate from Hope College with a major in a STEM discipline.

Currently, less than 50 students from the two largest local high schools, West Ottawa High School (WOHS) and Holland High School (HHS), enroll at Hope College each year and approximately 13 of these students are interested in pursuing STEM majors, which is a significantly smaller fraction of students expressing an interest in STEM fields than the overall entering class. With nearly 500 students graduating from WOHS each year and 260 graduating from HHS, it should be possible to **double** the number of local students interested in STEM majors that are *applying* to the college as they become more aware of the Hope STEM Scholars program. With a larger applicant pool, our long-term goal of doubling the number of local high school graduates that pursue science, engineering and mathematics majors at Hope College should be achieved.

Doubling the number of local students underrepresented in the sciences that are attending Hope is also quite feasible. While 39% of the WOHS students and 47% of HPS students are from groups underrepresented in the sciences, less than 20% of the WOHS and HHS alumni pursuing STEM majors at Hope are from underrepresented groups.[5,6] In addition to increasing ethnic and racial diversity of the STEM major population at Hope, the STEM Scholars project would also increase the economic diversity. Over a third of the student populations at both WOHS and HHS receive free or reduced-fee lunch. By providing financial assistance to students with economic need (through institutional grants and a pending NSF S-STEM scholarship Grant Proposal), the STEM programs at Hope will become more diverse and all students in the program will benefit from the new perspectives brought by the S-STEM scholarship participants.

Finally, while the overall retention rate of students at Hope College is good, the exact figure for retention within STEM fields is difficult to define. This is because students do not typically declare majors immediately upon enrolling in the college, thus it is difficult to track if they change their mind early in their college career. However, Hope STEM Scholars will be clearly identified before they begin their college career and thus special mentoring and cohort-building experiences to support them both socially and academically will begin before they officially arrive. The Scholars program will allow close relationships to be formed and better communication to take place between the Scholars and STEM faculty. The program should allow an even higher retention rate within the STEM disciplines for the Scholars.

**The goals for the Hope STEM Scholars program are to:**

1. more than double the number of students from the two target high schools beginning their college career with the intention of majoring in STEM fields. Currently 13 students are enrolling at Hope with the intention of majoring in STEM. The goal is to increase this number to at least 27.
2. significantly increase the diversity of the STEM major student population. Currently 90% of the student population at Hope College is non-Hispanic white. The diversity of the STEM major is comparable, meaning approximately 10 non-white STEM majors graduate each year. Due to the diversity of the local high school student body, an increase of 14 new STEM majors will also mean an increase of approximately 6 students of color in the Hope STEM classes, which is a 60% increase overall.
3. significantly increase the number of Hope STEM degree recipients from the local area. Currently, it is difficult to measure the number of students that change their plans to pursue careers in STEM fields, however, 40% of the incoming students express interests in STEM fields and only 20% of the members of the graduating class actually obtain STEM degrees. The goal of this program is to enable over 80% of the Hope STEM Scholars to complete bachelor's degrees in STEM fields at Hope College. This would lead to 11 additional degrees being granted, which is approximately a 10% increase for a total number of 128 STEM graduates each year.

**C. Hope STEM Scholars Program Plans**

The current plan for the Hope STEM Scholars program brings together several existing Hope programs that will be the source of the applicant pool for the Hope STEM Scholars program, as well as several new programs that will provide additional support and enable high retention of program participants. Specifically, the Hope STEM Scholars program will include:

1. Research and research-like experiences for students during their junior year in high school and the subsequent summer.
2. Student support and mentoring during their senior year in high school.
3. Research experiences for students after graduation from high school.
4. First-year experiences for Scholars during the academic year to build community.
5. Research experiences for STEM Scholars during the summer following their Freshman year at Hope.
6. Continual support in research and educational activities during their remaining three years in college to help develop professional skills.

The full program will involve interacting with STEM Scholars over a period of nearly six years. Only components of the last five years of programming would be supported by the funds requested in this STEP proposal, though all aspects of the program are described here for completeness. For ease in comparing budget years to program years, the timeline begins with year zero, the year before STEP funding would be utilized. During year zero, potential STEM Scholars would be participating in existing programs. Beginning in Year 1, programs funded by this request would begin.

**Year 0: Junior year in High School**

*Academic year STEM activities:*

STEM faculty members (including the PI) are working with local high school students in two different arenas to increase hands-on, investigative science components to the high school STEM classrooms. The first is through collaboration with the Hope College TRiO-Upward Bound program. This program serves students from area high schools. All participants have

demonstrated a desire to attend college and two-thirds of the participants either have demonstrated financial need or will be first-generation college students. Participants in the TRiO-Upward Bound program participate in tutoring programs as well as advising and informational events to help them learn more about career options and how to prepare for, select and apply for college. In recent years, 80% of the students participating in TRiO-Upward Bound at Hope College have remained in the program or graduated and 100% of the graduates enrolled in a college or university immediately upon graduation. The leadership of the TRiO-Upward Bound program will be working with the PI to develop hands-on investigative research-like experiences for the high school juniors and seniors in their program.

The PI is also working area high school teachers to bring research activities into their science and mathematics courses so that all students can participate in research and research-like activities. At this point, these endeavors are of rather small scale, but they will grow in scope over the course of the next year as the local high schools add International Baccalaureate (IB) courses offerings in the 2010 academic year.

*Summer STEM activities:*

During the summer AFTER the junior year in high school, local high school students are invited to participate in the Research Experiences Across Cultures at Hope (REACH) program. REACH was created in 2006 to:

- provide hands-on, high-quality and closely-mentored research opportunities for Holland-area high school students and teachers in order to engage them in the excitement of scientific discovery
- offer at least half of the REACH summer research positions to students from underrepresented groups that will go on to study STEM at the college level
- offer professional development opportunities for all of the REACH student participants by giving them valuable information about college and careers that will encourage them to pursue science in college and beyond
- work closely with Holland area students, parents, teachers, school administrators and business leaders to improve the communication and educational opportunities between Holland area students and teachers and Hope College faculty, staff and students.

The REACH program has positively impacted career path choices for 46 high school students in its first four years. Thus far, nine of 29 high school graduates REACH participants have enrolled at Hope College. This is especially encouraging considering that the REACH experience makes many of the participants very competitive for admission and scholarships at major research universities. Participants in the REACH program engage in question and answer sessions with college admissions and financial aid staff in order to help address concerns about financial constraints. However, even after these efforts by our admissions and financial aid offices, many of the REACH students with financial need still feel that they cannot afford Hope College. The existence of the Hope STEM Scholars program would figure prominently in the REACH student discussions in future summers in order to help reduce the financial concerns. The fourteen REACH participants from the summer of 2009 have been encouraged to apply to Hope College. They will also be eligible for the Hope STEM Scholars program, should this proposal be funded.

The REACH program is supported by several different sources including a grant from the Howard Hughes Medical Institute, individual investigator grants to Hope College Faculty and institutional funds. The goal is to continue to expand the program to provide opportunities for an additional 14 students. The PI and the Hope College advancement team are currently pursuing funding to enable this expansion.

## **Year 1: Senior year in High School**

### *Academic year STEM activities:*

After completing the REACH program, students currently return to their high school programs and have occasional contact with the REACH program coordinator, but little other interaction with Hope faculty and staff. REACH alumni that are involved in the TRiO-Upward Bound program continue to come to campus for tutoring, but there is little direct involvement with STEM faculty/staff. As the STEM Scholars program begins to build, the PI, local science and mathematics teachers and TRiO-Upward Bound staff will continue to add research and research-like components into the high school STEM courses. Students involved in IB courses will be required to complete independent research projects. Hope faculty will serve as consultants to the teachers and students as these projects develop. In addition, the Hope STEM Scholars program will build upon the relationships forged during the summer REACH experience to help local high school students interested in STEM fields navigate through the process of applying to college and pursuing financial aid. This support will come in the form of occasional “reunion” gatherings either at the high schools or at Hope College. The goal of this component is to provide the support needed to help all potential STEM majors in the local schools find the answers to their questions and help them find the college or university that best matches their needs and abilities.

In “Crossing the Finish Line: Completing College at America’s Public Universities”, W.G. Bowen, et. al. report that a significant number of high school seniors choose to pursue degrees at less selective four-year and two-year colleges, or no college at all, rather than pursuing degrees at more selective four-year institutions.[7] Graduation rates are significantly higher and time-to-degree is shorter at the selective institutions. Thus by working with local students to help them find the best fit to their needs, overall STEM graduation rates may improve for these students, even if they choose not to attend Hope College.

One reason students may choose not to attend selective four-year institutions like Hope is a perception that they cannot afford the cost of attendance. To help alleviate this perception, an NSF S-STEM grant proposal has been submitted that will support college scholarships and several of the first-year experiences for the Scholars. While it is possible that the S-STEM proposal will not be funded, the Hope STEM Scholars program will proceed regardless. The S-STEM scholarships provide a high profile source of financial support for local students, many of whom will qualify for financial aid. However, the college financial aid office will work with the STEM Scholars to find other sources of aid if the S-STEM scholarship proposal is unsuccessful.

### *Summer STEM activities:*

The final component of the high school senior program will be a summer research program. Programs which include collaborative research experience with faculty have been shown to improve retention rates in STEM programs.[8] The summer research program will build upon the already successful REACH program by engaging 14 Hope STEM Scholars in research with STEM faculty researchers and Hope undergraduates immediately after they graduate from high school. The applicant pool for the Hope STEM Scholars program will be the REACH and Upward Bound alumni. These STEM Scholars must be admitted to Hope College and be planning to begin college in the fall semester immediately following their graduation from high school. These students will do research side-by-side with Hope students and faculty and begin to build connections and relationships that will help them make the transition from high school to college. Since they are all local area students, they will be able to maintain connections to family and friends during the process. Activities will be planned throughout the summer to help the STEM Scholars form a cohort and get to know faculty mentors in the Scholars program beyond their research mentor. These personal relationships between STEM majors and STEM faculty have been reported to have a major impact on students’ decisions to stay in STEM fields and are likely to improve retention of the STEM scholars in STEM majors.[4]

## **Year 2: Freshman year at Hope College**

### *Academic year STEM activities:*

First-Year Seminars are required courses for all Hope College students during the fall semester of their initial year. First-Year Seminars are small, discussion-driven classes taught by professors who serve as academic advisors for students in their seminar. The First-Year Seminar helps introduce new college students to the life of the mind and to the kind of college-level learning expected in other classes at Hope College. Each section of the First-Year Seminar focuses on a different topic that is chosen by the professor. PI Mader and co-PI Dershem have taught FYS on several occasions. Both will work with one other STEM faculty member to develop an FYS for the Hope STEM Scholar cohort based on a successful course offered by co-PI Dershem in the past entitled “The Paleness and Maleness of Science and Engineering”. This course focused on describing the lack of diversity in science and engineering, investigating its cause, discovering why diversity is important in these fields, and discussing how diversity might be increased. Considerations in this course encompassed gender, ethnic, and cultural diversity and included review of scientific studies investigating the desirability and current levels of diversity as well as possible causes of its lack. In the process of exploring this topic, the students were introduced to college-level reading and writing expectations, and their time management skills and literature research skills were honed.

Because the STEM Scholars will all be from one of two local high schools, there is concern that there will be a lack of geographical and cultural diversity in the classroom. Thus two sections of the First-Year Seminar will be offered and additional STEM majors from different geographical regions will be included in these sections. Two faculty members, the PI and one other member of the STEM Scholar steering committee will develop the course together and have common guest speakers and off-campus activities that will help to keep the cohort together even though they are in separate sections of the class.

The STEM Scholars will also be encouraged to continue to engage in research during the academic year. Scholars can enroll in a one-credit research course OR will utilize their work-study support to continue their research activities for pay. Many upper-level students at Hope participate in research for credit or pay; however few first-year students do so. This is primarily due to the fact that they do not yet know any STEM faculty and cannot identify a mentor. Since the Scholars will already have worked with a Hope College STEM research group, this barrier will be removed.

STEM Scholars will be encouraged to attend, and if appropriate, present the results of their research at regional meetings, such as the Midstates Consortium Undergraduate Research Symposia, the West Michigan Regional Undergraduate Research Conference and the Argonne Symposium for Undergraduates in Science, Engineering and Mathematics. Participation in these meetings will not only provide the Scholars with the opportunity to build their scientific communication skills, it will also allow them to interact with other undergraduate researchers. They will learn about other areas of STEM research as well as begin to build a network of STEM colleagues.

### *Summer STEM activities:*

One of the hallmarks of a Hope STEM education is the 10 week summer undergraduate research experience. A significant number of the Hope STEM majors participate in research experiences on campus at least one summer and many repeat the experience for two or three summers. Hope STEM Scholars that have made adequate progress through their STEM degree program at the end of their first year will be able to continue to do research during the summer following their freshman year. In the ideal case, the student will continue in the same research group they had worked with in the previous summer. In some cases, the interests of the student



and research mentor may not coincide and the student will be placed in a new program that better matches their needs and interests.

### **Years 3-5: Sophomore, Junior and Senior years at Hope College**

Hope STEM Scholars would continue to participate in research during the academic year their entire academic career either through research courses or through work study appointments. In addition, the Scholars would be encouraged to participate in a professional development seminar series (typically once or twice a month in the evenings or over lunch) designed to help them grow as students, as scientists and as individuals during their college career. First year students would also be encouraged to attend these seminars which would help them to meet the more senior STEM Scholars. This would allow the experienced STEM Scholars to interact with younger Scholars and possibly help the young students identify role models and friends.

In addition, the seminars will also help keep the STEM Scholars connected with their high school community, since several of their classmates will have attended the same high school and are likely to have taken the same science and mathematics courses. We anticipate that successive cohorts will also be instrumental for future recruiting efforts at the local high schools.

The seminar series will be organized by a team consisting of PI Mader, co-PI Dershem and two other individuals, with guidance from the STEM Scholars steering committee:

- The college has recently hired a STEM Mentoring Director. This position was funded by a recent grant from the Howard Hughes Medical Institute. This mentoring program will provide both social and academic support to all students from underrepresented groups who are enrolled in STEM courses. The goals for the Mentoring program and the Scholars program overlap significantly.
- The director of the Office of Multicultural Education (OME) will also serve on this team. The goal of the OME is to promote education, understanding across racial and cultural boundaries and a safe environment where all students, faculty and staff are able to find creative ways for understanding mutuality and respect. Using a variety of approaches, such as workshops, lectures, interactive programs, films, discussions and others, the Office seeks to cultivate understanding that promotes justice, respect and an environment where all persons are valued. With the advice and guidance of colleagues at Hope College, the OME seeks to assist students with the requisite skills, knowledge, and understanding for living in a global society.

The seminars and discussions will address several factors that have been shown to impact students' decision to seek a STEM degree as well as their persistence in that degree program. For west Michigan STEM majors, these factors include the job market and time to degree.[4] Even before the current economic downturn, west Michigan students appeared to perceive that job prospects were not good for STEM bachelor degree holders. Both availability of jobs and salary levels seem to be of concern. Students also are concerned about the cost and time associated with pursuing advanced degrees in STEM fields. The Scholars will be encouraged to discuss these concerns and others with fellow Scholars, faculty and career services staff. By helping students to explore career path options for STEM majors, two of the largest factors leading to students changing majors to non-STEM fields may be alleviated.

The seminars will provide opportunities to remind students of support services available to them. Early in their careers, the Academic Support Center and Office of Multicultural Education may be of great assistance, but as time progresses, offices which help student find off-campus experiences such as internships or research experiences will be discussed. The seminars will help them identify opportunities that help build not only the technical skills needed to be productive members of the STEM workforce, but the life-skills needed to succeed in their chosen careers in a global society.

Opportunities to meet and learn from professionals in the STEM workforce outside of academe will also be provided. Guest speakers from the West Michigan area will be invited to come to Hope's campus to share their experiences. The Scholars will be taken off campus to meet STEM professionals at their place of work. For example, Argonne National Laboratory is only three hours away and hosts several events throughout the academic year for undergraduate STEM majors. The Scholars will be able to participate in these events. Several local companies have research and development facilities and have always been willing to meet with our students.

In addition to programmed activities, the PI will work with each STEM Scholar to help them build a mentor/protégé relationship. In many cases, the mentor is likely to be their research advisor, but in cases where this relationship does not develop into a mentor/protégé relationship, the Scholar's academic advisor or the Director for Mentoring or some other member of the Hope College community will step into that role.

## **D. Significance of Project**

### **Integrating Diversity into NSF Programs, Projects, and Activities**

This program will increase opportunities for students with economic challenges to attend a college with excellent STEM educational opportunities close to home. While Hope does offer excellent aid packages to students with financial needs, many local students do not even apply currently. While Hope students engaged in research typically earn wages/stipends, students currently cannot qualify for these jobs until, at best, the end of their first year of college. Thus the high quality and costs of the Hope College education are considered to be out of reach for many local students. This phenomenon is not unique to Hope College. In "Crossing the Finish Line", a study of graduation rates at 68 colleges and universities, the authors indicate that highly qualified students from low income families simply do not apply to colleges or universities that appear to be expensive, choosing instead to attend less expensive schools.[9] These students do not complete their degrees at the rate predicted by their GPAs and test scores. Publicity about the Hope STEM Scholars program and possibly the S-STEM Scholarship program will make the local community aware of the fact that Hope is, in fact, affordable. In addition, the publicity will provide an opportunity to share information about the quality of the support programs and STEM major success rates.

### **Integration of Research and Education**

One key aspect of the mission of division of Natural and Applied Sciences is that science is best learned by doing science, not talking about it or reading about it. The STEM faculty members feel so strongly about this that many of the division's major programs have incorporated research-like experiences in their curriculum. In addition, many researchers bring aspects of their current research into the classroom, both to motivate the students and to teach them. Unfortunately, potential STEM majors are often not identified until after they are well into their first year of courses and thus won't be invited to join research groups until after their first year of college. Thus, should they become discouraged about their STEM coursework; they may choose to change their major field before ever getting the opportunity to DO science. Thus the Scholars program will identify STEM majors early, engage them in STEM research programs early and support them through the challenging transition points in their STEM education career.

### **Broader Impacts**

Currently, ~120 Hope College students earn bachelors degrees in STEM fields each year. By increasing this number by 12% per year, 14 young adults with strong STEM educations will be able to pursue post-graduate degrees or directly enter the workforce. A significant number (10%-50% depending on discipline) of Hope STEM alumni pursue post-graduate studies in science and engineering fields. Recent studies have shown that the likelihood that STEM majors will pursue

advanced degrees is directly correlated to the amount of debt incurred while pursuing a bachelor's degree.[10] The financial support provided to STEM Scholars will not only help make their undergraduate education possible, it will reduce the debt burden the recipients will face upon graduation. This will in turn increase the likelihood that these students will pursue post-graduate education as well.

In addition, due to demographics of the local area, the STEM Scholars will also include a larger fraction of underrepresented minorities and students from diverse socioeconomic backgrounds than the current undergraduate population at Hope College. Even with only 14 Scholars, the fractional increase will be significant and will have a significant impact on the STEM faculty and student body.

In addition, by building a strong connection between Hope College and the local high school graduates, the educators in both programs will also build stronger connections. Administrators and teachers at local high schools are very interested in bringing research experiences into their classrooms, and the Hope STEM Scholars and their mentors will serve as great role models and potential mentors for the high school students. Thus while only 14 new STEM majors will be directly funded by this proposed project each year, a significantly larger number of high school science students and teachers will be affected.

### **Intellectual Merit**

The proposed project will bring diverse, young and enthusiastic researchers together with experienced research teams at Hope College. Most of these research teams are engaged in programs that are supported by grants from external sources. These grants were awarded because the scientific studies were deemed significant and worthwhile. Thus the STEM Scholars will be engaged in generating new knowledge and will experience doing science first hand at an early stage in their career. Based on assessment of similar programs that engage Hope students in research, they will not only build skills, but confidence in their ability to do science. They will also begin to self-identify as scientists.[11] Thus this program will not only advance the scientific knowledge in the fields studied by the STEM Scholars, it will advance the growth of the STEM Scholars as scientists.

### **E. Hope STEM Scholars Project Management Plan**

The Hope STEM Scholars program and will be led by the PI, Dr. Catherine Mader, Professor of Physics and co-PIs Dr. Moses Lee, Dean of Natural and Applied Sciences and professor of Chemistry and Dr. Herb Dershem, Director of Institutional Research and Professor of Computer Science.

While some components of the Hope STEM Scholars program will be developed to address concerns about retention of students on the campus as a whole, others have been developed to address factors that can negatively affect retention of students underrepresented on the Hope campus or within STEM disciplines.[12,13,14] One key feature of the program described within this proposal is that care will be taken to ensure that one individual, the Hope STEM Scholar program director (the PI), will interact regularly not only with student participants, but with faculty and staff members that are directing various support services and programs. The program director will strive to keep all of the many programs working cohesively and coherently. The program director will be tasked with monitoring student progress as well as how well the support programs are meeting student needs.

Of course, the program director will need support and input from the larger community. Thus a **local steering committee** of Hope STEM faculty and directors of related programs will advise the PI and coPIs and help to provide a seamless and coherent set of programs for Hope STEM scholars. The steering committee will include:

- James Boelkins, Provost
- Darin Stephenson, Professor of Mathematics
- Kathy Winnett-Murray, Professor of Biology
- Mike Jipping, Professor of Computer Science

- Brian Bodenbender, Professor of Geology and Environmental Sciences
- Michael Misovich, Professor of Engineering
- Joanne Stewart, Professor of Chemistry & Hope College HHMI grant program director
- Karen Nordell Pearson, Director of the REACH Program
- Liz Colburn, Director of Hope College Upward Bound
- Vanessa Greene, Director of Office of Multicultural Education

The steering committee will meet in the winter to review candidates for the Hope STEM Scholars program and to begin the process of identifying research mentors for the scholars. They will meet in mid- to late- summer to review any assessment results available at that time. The programs planned for the upcoming academic year will also be reviewed and modified based on the assessment information and the suggestions of the steering committee. It is possible that additional meetings will be necessary in the earliest stages in order to work out any problems encountered in launching this new and rather large endeavor. Since the committee is local, these additional meetings will not be difficult to arrange.

The Holland High School and West Ottawa High School administration will also be invited to attend steering committee meetings. At West Ottawa High School, both the Superintendent and Principle have been involved in preliminary planning. At Holland High School, the Superintendent of Curriculum and Instruction and the Science department chair have been involved. Their insights and suggestions have played a significant role in the initial planning for the Hope STEM Scholar program. Their continued involvement will help the steering committee to learn how the Hope STEM Scholars program is impacting the high school programs and ways in which the STEM Scholars program can better connect with high school science and mathematics students and teachers.

A three-member **external advisory committee** will also be created to provide additional insights to the program directors as the program is begun as well as to review annual progress. The external advisory committee will consist of individuals familiar with undergraduate research programs, individuals familiar with liberal arts colleges and individuals familiar with bridge and mentoring programs. While the literature suggests that the programs outlined in this proposal are likely to have a positive impact on recruitment and retention of STEM majors, the members of this committee will provide personal insights that will greatly strengthen the program.

## **F. Student Recruitment and Selection**

### **Recruitment**

Students will be recruited for the Hope STEM scholars from the 2009 REACH participants and from the current Upward Bound program participants that are attending West Ottawa or Holland High school. Currently, the participant pool is approximately 20 students. While the REACH program is primarily a summer research program, many of the 2009 participants are still enrolled at one of the area high schools and are in touch with their research mentors and Dr. Karen Nordell Pearson, the Director of the REACH program. The PI will work with these Hope community members to make the REACH alumni aware of the opportunity.

The Upward Bound students are on the Hope College campus several times each week. In addition to academic activities, they will participate in professional development activities. The PI will work closely with Liz Coburn, the Director of Hope College Upward Bound, to make the Upward Bound students aware of the Hope STEM Scholars program.

Participants in the REACH and Upward Bound programs are invited to apply to Hope College. Those that are admitted will be encouraged to apply for the Hope STEM Scholars program by submitting an essay discussing their desire to pursue a college degree in a STEM field and a letter of recommendation by a teacher or mentor who can address their potential for successfully earning a STEM degree from Hope College. A selection committee comprised of a subset of the leadership group will review the applications. As with the REACH application process, quantitative information

such as high school GPAs and entrance exam scores will be considered in addition to the essay and recommendation in order to rank students on likelihood of successful completion of STEM degree at Hope.

### **Selection**

The Hope STEM Scholars review committee will look for students who express an interest in STEM research and are recommended by their teachers or prior research mentors as hardworking, well-prepared and eager for this opportunity. Since students will have already been admitted to the college, their likelihood for success at Hope College will have been assessed. Thus the committee will focus on the likelihood that they will successfully complete a STEM degree at Hope. Because we are focusing on providing Scholars the opportunity to discuss and experience the benefit of diversity in the STEM endeavor, applicants with a variety of educational experiences and expectations will play a role in the selection process. Thus GPA is not the only factor in the participant selection. The content of the student essays, teacher recommendations, area of STEM interest and GPAs are all considered when trying to select students that are well-suited for the opportunities and challenges of the program.

### **G. Sustainability**

Many of the aspects of the Hope STEM Scholars program are already in place. This proposal seeks funding primarily to support new summer research opportunities for the Scholars. In addition, it will provide the opportunity to connect all of the existing programs through a leadership team that is involved in all aspects of the program and an advisory committee that will include members from each of these existing programs as well as from the local community. The involvement of individuals in all aspects of the Hope STEM Scholars program for six years, beginning in the junior year of high school and continuing until their graduation from Hope College will help to provide continual support to these students through critical transition points in their academic careers.

Many aspects of this program are building on existing expertise and programs. However, this proposal provides the support to allow the STEM Scholar program director to work with the various support staff and faculty members to build a coherent program for the students. While this will be a time-intensive project initially, once the connections are established and the program is designed, the time commitment needed by the program director should decrease. Thus one aspect of institutionalization will be the inclusion of Scholar responsibilities within the existing support staff's regular activities.

In addition, the new STEM mentoring director will be creating a program that complements the academic year components of the STEM Scholars program. They will also assist new STEM majors in building a mentor/protégé relationship while they are on campus. As this new support staff member develops the mentoring program, supervision of the Scholars academic year programming, including the student mentoring aspects, will transition from the PI to the Mentoring Director. The gradual transition from the PI as leader of the academic year programming to the Mentoring Director is anticipated within this request by the decrease in PI salary over the duration of the grant period.

Building and maintaining connections with the local high schools and the Hope TRiO-Upward Bound programs are the other major commitments that the PI must maintain. These relationships are already growing stronger due to the efforts of the director of the REACH program. As the project begins, the PI will work with the REACH director to increase connectivity and interaction. However, as with the Mentoring director, it is anticipated that the REACH director's responsibilities will grow to include maintaining the relationships with Hope TRiO-Upward Bound for all aspects of the Hope STEM Scholars program, not just the REACH component.

Perhaps the most challenging component of the program to support financially is the summer research program. However, the faculty within the Division of Natural and Applied Sciences has a long track record of securing funding to support their research programs. This will always be a source

of support for some of the STEM Scholars program. In addition, the college advancement team is already working to build an endowment to support the program once this grant period expires.

The Division of Natural and Applied Science at Hope College's vision 20/20 plan has the goals of increasing our academic excellence to a higher and uncharted level, as well as broadening the participation of underrepresented students in divisional teaching and research programs. As a result of the second goal, the successful REACH program was started in summer 2006. The division is committed to the success of REACH and the dean's office has consistently provided financial support of this program. The Natural and Applied Science division will be equally committed to the success of the Hope STEM Scholars program and both STEM department and divisional resources will also be applied to support the program.

## **H. Assessment and Evaluation**

### **Formative Assessment**

The following will be used for formative assessment during the project. All data will be used for evaluation purposes by the steering committee, which will meet at the end of each academic year to evaluate assessment data and recommend adjustments to the program.

1. *Tracking data for Hope STEM Scholars.*

Data collected will include progress toward degree, academic performance, participation in internship and research, retention in the major, graduation rate, job placement, and percentage of minorities and females. The data for STEM Scholars will be compared to results prior to STEM Scholar support and to the results for non-STEM Scholar majors in STEM disciplines during the period of this project.

2. *Annual survey of all participants.*

All participants in this program (students, steering committee members, and faculty advisors) will be surveyed annually to determine the impact of the program. Student participants will also be surveyed prior to their arrival on the Hope campus. The student survey will be open ended in order to obtain as much detail as possible about the strengths and weaknesses of the program. The results of these surveys will be used by the Steering Committee to determine the effectiveness of various strategies and to modify those that could be improved.

3. *Exit survey.*

All participants, when exiting the program, will be asked to complete a survey. There will be separate surveys for students who depart the program prior to graduating and for those who graduate as STEM scholars.

4. *Applications from students at targeted high schools.*

The number of applications to Hope College from students at the targeted high schools will be collected each year and compared with counts from years prior to the STEM Scholars program.

### **Summative Assessment**

The objectives of this project are listed below along with the assessment data that will be used to evaluate each one.

1. *To double the number of local high school students applying to Hope College with intentions to major in STEM fields.*

This will be evaluated by the number of applications for admission to Hope received from the students at the targeted high schools.

2. *To increase the diversity of Hope STEM major population by doubling the number of students from local high schools that attend Hope College and major in STEM fields.*

Applications to Hope College from local high school students who are interested in majoring in STEM fields will be tabulated during the project and compared with corresponding data in years prior to the project.

3. *To increase the number of targeted students who graduate from Hope College with a major in a STEM discipline.*

Retention and graduation data will be collected for STEM majors during and after the project and compared with similar data from before the project.

All data collection and survey design will be coordinated by the PI in consultation with the Hope College Frost Center for Social Science Research. Similar on-line instruments already exist for the assessment and evaluation of the current Hope College CSEMS and S-STEM programs as well as the REACH summer research program. These instruments will be adapted for use in the STEM Scholars program.

Results of this program will be disseminated through the construction of a project web page. This web page will contain complete information about the project, including all assessment data. The availability of this web page will be announced through the web pages of all of the participating departments and the web page of the Hope College Natural and Applied Sciences Division.

## I. Results of Prior Funding

Hope College is currently receiving NSF support for a CSEMS project DUE-0422388, "CSEMS Scholarship Program in Computer Science, Engineering, and Mathematics" and S-STEM project DUE-0728574. The CoPI for this current S-STEM proposal is the PI for both of these current grants. The CSEMS project, in its sixth year of six, has supported 34 undergraduate students in the study of computer science, engineering, and mathematics at Hope College. These students have been enrolled in a focused first-year seminar and have received additional counseling and assistance through the CSEMS program. The goals of this CSEMS project are to increase the enrollment and retention of students in underrepresented groups in the CSEMS disciplines at Hope College. Preliminary assessment data for this project are included in Table 1 below.

Noteworthy in Table 1 are the following:

- Retention at Hope of CSEMS participants significantly exceeds the overall campus retention percentage. (**97%** to **88%** for 1 year, **94%** to **82%** for 2, and **94%** to **80%** for 3)
- Although CSEMS recipients are not selected for academic excellence and their course work is more demanding than typical Hope students, their GPAs exceed the institutional average. (**3.42** to **3.30**)
- While the percentage of females in CSEMS is about half of the institution's, it exceeds the overall average in the CSEMS disciplines. (**29%** to **23%**)
- The percentage of CSEMS students from minority groups greatly exceeds the institutional percentage. (**12%** to **4%**)

All of these preliminary figures point to success in meeting the goals of the CSEMS project.

**Table 3: Summary of Results from Hope College CSEMS Project DUE-0422388**

Start	N	Retention at Hope				Retention in CSEMS Field				Ave GPA	Female	URM
		1 yr	2 yr	3 yr	4 yr	1 yr	2 yr	3 yr	4 yr			
<b>2004</b>	6	100%	100%	100%	100%	83%	83%	83%	83%	3.29	50%	17%
<b>2005</b>	16	94%	94%	94%	94%	100%	94%	81%	81%	3.56	25%	13%
<b>2006</b>	12	100%	92%	92%	-	100%	92%	92%	-	3.35	25%	8%
<b>Total</b>	34	97%	94%	94%	95%	97%	91%	85%	82%	3.42	29%	12%
<b>College</b>	3203	88%	82%	80%	77%					3.30		4%

The proposed project has a much different focus than the ongoing S-STEM project in that the ongoing project, which is currently in its second year of a three year program, provides scholarships exclusively for transfer students from two-year colleges. The first cohort of seven two-year college

transfers students arrived on the Hope College campus in Fall 2008 and have completed their first year of study at Hope. Five of these students will continue into their second year of study in a STEM discipline at Hope, one student will remain at Hope but not in a STEM discipline, and one student has transferred out of Hope College. A second cohort of seven two-year college transfer students has been recruited into the program, most of whom have participated in undergraduate research at Hope in the summer of 2009. These seven students are currently enrolled as majors in a STEM discipline in the fall of 2009.

In addition to these two scholarship grants, Hope College currently receives NSF support for five REU site programs (biology, chemistry, computer science, mathematics, physics and engineering), in which many of the S-STEM and CSEMS scholarship recipients participate. The PI of this S-STEM proposal is the PI of the physics and engineering REU site grant (NSF REU-0452206). The physics and engineering NSF REU site program has been continually funded since 1996 with the 2009 summer being the fifth summer of five for the current grant award. This most recent grant has supported eight or nine undergraduates each summer. In addition, three high school students have been supported, in part due to two REU supplements awarded in the summers of 2008 and 2009. In total, 42 undergraduates and three high school students have been supported by the grant. Of the 30 participants that have completed an additional year of college, all but two have continued on in their STEM degree plans.

The Hope College Physics and Engineering REU Site program has the goals of engaging (i) young students, (ii) students in underrepresented groups in physics and engineering and (iii) students from colleges at which closely mentored research experiences that lead to the generation of new knowledge are less common. The program has been quite successful in this endeavor as over half of the participants are underrepresented in physics and engineering (23 females, three African Americans, two Hispanics and two Asian Americans) and over half of our non-Hope students are from small colleges and two-year colleges. The work has led to over 17 articles published through 2008 and over a dozen undergraduates have presented the results of their work at national and regional meetings.

Our undergraduate research program in physics and engineering is not unique at Hope. Over 160 high school and undergraduate students participate in research in STEM fields every summer. Of the over 140 undergraduates conducting research in the summer, the NSF-REU site programs support approximately 25% of the students, individual investigator grants from funding agencies such as NSF, NIH, DHS and NASA support approximately 25% of the students and approximately 50% are supported by student scholarships and endowed college funds. The demographics and success rates in all fields are comparable to those reported above.

**Table 4: Summary of Student participation in Hope Physics and Engineering REU Site program NSF REU 0542206**

Summer Date	Number of participants	Male	Female	Hope	Non-Hope	College Freshman	College Sophomore	College Junior	High school
2005	9	2	7	5	4	1	4	4	0
2006	8	6	3	5	4	1	4	3	0
2007	8	3	5	4	4	1	4	3	0
2008	10	7	3	4	6	3	4	2	1
2009	10	4	5	3	7	3	2	3	2
<b>Total</b>	45	22	23	21	25	8	18	15	3



## References

- [1] Hess, F.M., Schneider, M., Carey, K., Kelly, A.P. “Diplomas and Dropouts. Which Colleges Actually Graduate their Students (and Which Don’t)”, American Enterprise Institute, (2009): 51. (<http://www.aei.org/docLib/Diplomas%20and%20Dropouts%20final.pdf>)
- [2] A partial report is posted online. Full report requires registration at the site:  
[http://www.researchcrossroads.org/index.php?option=com\\_content&view=article&id=241&Itemid=20state=michigan](http://www.researchcrossroads.org/index.php?option=com_content&view=article&id=241&Itemid=20state=michigan)
- [3] Wells, B.H., Sanchez, H.A. and Attridge, J.M., “Modeling Student Interest in Science, Technology, Engineering and Mathematics”, Raytheon Corporation report for the Business-Higher Education Forum ([http://www.bhef.com/publications/documents/raytheon\\_paper.pdf](http://www.bhef.com/publications/documents/raytheon_paper.pdf))
- [4] Carlson, N., Stek, A., “Cultivating STEM: Why West Michigan college students select majors in Science, Technology, Engineering and Mathematics.” Center for Social Research at Calvin College (May 2009).  
([http://www.calvin.edu/admin/csr/weblog/files/Cultivating\\_STEM.pdf](http://www.calvin.edu/admin/csr/weblog/files/Cultivating_STEM.pdf))
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- [6] Trujillo, B. (2008). 2007-2008 Annual Education Report: Holland High School. ([http://www.hollandpublicschools.org/pages/uploaded\\_files/HS Annual report2008 \(Repaired\).doc](http://www.hollandpublicschools.org/pages/uploaded_files/HS%20Annual%20report2008%20(Repaired).doc))
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- [8] Nagda, B.A., Gregerman, S.R., Jonides, J., von Hippel, W., and Lerner, J.S. (1998). Undergraduate student-faculty research partnerships affect student retention. *The Review of Higher Education*, 22(1): 55-72.  
([http://muse.jhu.edu/journals/review\\_of\\_higher\\_education/v022/22.1nagda.html](http://muse.jhu.edu/journals/review_of_higher_education/v022/22.1nagda.html))
- [9] Bowen, W.G., Chingos M.W. and McPherson, M.S. (2009). *Crossing the Finish Line: Completing College at America's Public Universities*, Princeton University Press, p6-7.  
(<http://press.princeton.edu/titles/8971.html>)
- [10] Commission on Professionals in Science and Technology (June, 2004). *Debt Burden of Science and Engineering Doctorates—Differences by Race/Ethnicity*.  
(<http://www.cpst.org/web/site/pages/pubs/minfo.cfm?xPubNum=26>)
- [11] Seymour, E., Hunter, A.-B., Laursen, S., and DeAntoni, T. (2004). Establishing the benefits of research experiences for undergraduates: first findings from a three-year study. *Sci. Educ.*, 88,493 -594
- [12] Tinto, V. (2006-2007). *Research and Practice of Student Retention: What Next?\**, *J. College Student Retention*, Vol 8(1), 1-19.  
([http://www.uaa.alaska.edu/governance/facultysenate/upload/jcsr\\_tinto\\_2006-07\\_retention.pdf](http://www.uaa.alaska.edu/governance/facultysenate/upload/jcsr_tinto_2006-07_retention.pdf))
- [13] Seymour, E., Hewitt, N. (1997). *Talking about Leaving: Why Undergraduates Leave the Sciences* (Westview Press, Boulder, CO).
- [14] Miller, L. S. (2005). *Retention by Design: Achieving Excellence in Minority Engineering Education*. White Plains, New York: National Action Council for Minorities in Engineering.

## CATHERINE MADER

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Department of Physics, Hope College  
Holland, Michigan 49423  
(616) 395-7114, EMAIL:MADER@hope.edu

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### PROFESSIONAL PREPARATION

**Michigan State University**, Ph.D., Physics, 1993.

*Equilibrium and Non-Equilibrium Models for Particle Production in Heavy Ion Collisions*

**Colorado School of Mines**, M.Sc., Engineering Physics, 1989.

*Sub-Coulomb Deuteron-Nucleus Collisions Using the Cayley Equation*

**Colorado School of Mines**, B.Sc., Engineering Physics, Nuclear Energy (minor) 1987.

### APPOINTMENTS

#### Hope College

Professor	2009 – present
Chair, Department of Physics	2006 – 2009
Chair, Department of Physics & Engineering	2005 – 2006
Acting Chair, Department of Physics & Engineering	2004 – 2005
Associate Professor	1999 – 2009
Assistant Professor	1994 – 1999
Visiting Assistant Professor	1993 – 1994

#### American Physical Society

Education Project Consultant	2007 - present
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#### Lawrence Berkeley National Laboratory

Visiting Scientist	2000 - 2001
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### PUBLICATIONS

#### (UNDERGRADUATES INDICATED WITH \*)

John Krupczak, Jr., Joseph Kaloust, Michael Misovich, Janice Pawloski, Roger Veldman, Paul DeYoung, Peter Gonthier, Catherine Mader, and Mark Little, “Results from Replacing General Physics with Introduction to Engineering in the First Year”, Proceedings of the American Society for Engineering Education Annual Conference (2004).

C. M. Mader, A. Chappars\*, J. B. Elliot, L. G. Moretto, L. Phair, G. J. Wozniak, “The three-dimensional Ising model: A paradigm of liquid-vapor coexistence in nuclear multifragmentation”, Phys. Rev. C68, 064601 (2003).

L. G. Moretto, J. B. Elliot, L. Phair, G. J. Wozniak, C. M. Mader, A. Chappars\*, “Theoretical approaches and experimental evidence for liquid-vapor phase transitions in nuclei”, AIP Conference Proceedings, April 2, 2002 610, 182-196 (2002).

G. F. Peaslee, C. M. Mader, P. L. Jolivet, P. A. DeYoung, “The Restructured Advanced Laboratory at Hope College - A Step Toward Independence”; Application of Accelerators in Research and Industry: 15th International Conference, AIP Press 475, 1110-1113 (1999).

P. A. DeYoung, C. Dykstra\*, P. Gonthier, C. Mader, G. F. Peaslee, D. Peterson, R. Sedlar, S. Sundbeck\*, N. Shaw\*, G. D. Westfall, D. Craig, R. A. Lacey, T. Li, T. Reposeur, A. M. VanderMolen, J. Winfield, S. J. Yennello, A. Nadasen, "Sensitivity of small-angle correlations of light charged particles to reaction mechanisms in the  $16\text{O} + {}^{27}\text{Al}$  Reaction at 44 MeV/nucleon", Phys. Rev. C56, 244 (1997).

### **SYNERGISTIC ACTIVITIES**

Reviewer for NSF-REU, RUI, CCLI, STEP and MSP programs; Research Corporation; Project SPIN; Am. Journal of Physics; several textbooks; External Departmental review team member for several colleges  
Project Kaleidoscope Faculty 21  
Council on Undergraduate Research, CUR Physics and Astronomy Councilor and Nominations Committee member (2006-present)  
Society of Physics Students - Zone Councilor SPS (2005-2007)  
American Physical Society – Committee on Careers and Professional Development member

### **OTHER PROFESSIONAL AFFILIATIONS**

American Physical Society (member of Division of Nuclear Physics and Forum on Education member)  
American Association of University Women  
Sigma Xi  
American Association of Physics Teachers

## Biographical Sketches

**Co-Principal Investigator: Herbert L. Dershem**

### **(i) Professional Preparation**

B.S. University of Dayton, 1965

M.S. (Computer Science) Purdue University, 1967

Ph.D. (Computer Science) Purdue University, 1969

### **(ii) Appointments**

Hope College, Assistant Professor, 1969-1974, Associate Professor, 1974-1981,  
Professor, 1981-present, Chair, Computer Science Dept, 1976-2003, Interim Dean  
for Natural Science, 2005, Director of Institutional Research, 2007-present.

United States Air Force Academy, Distinguished Visiting Professor, 1993-1994

Boston University Overseas Program, Visiting Professor, 1982-1983

Oak Ridge National Laboratories, Visiting Research Scientist, 1977-1978

### **(iii) Publications**

#### **Up to 5 publications most closely related to the proposed project:**

Pearson, K.N., Brown, K.L., Dershem, H.L., Winnett-Murray, K., Barney, C.C., and  
M.N.F. Lee, "Enriching a Culture of Research: Expanding Opportunities to a Broader  
Community, chapter in *Broadening Participation in Undergraduate Research:  
Fostering Excellence and Enhancing the Impact*, editors Mary K. Boyd and Jodi L.  
Wesemann, Council on Undergraduate Research, Council on Undergraduate  
Research, 2009.

Dershem, H.L., McFall, R.L., and N. Uti\*, "A Linked List Prototype for the Visual  
Representation of Abstract Data Types," *Interactive Multimedia Electronic Journal of  
Computer-Enhanced Learning*, 4,2(Oct, 2002).

Dershem, H.L., McFall, R.L., and N. Uti\*, "Animation of Java Linked Lists," *SIGCSE  
Bulletin*, 34,1(Mar, 2001), 53-57.

Dershem, H.L., Dykstra\*, J., and K. Suppes\*, "An Abstract Window Toolkit Visualizer  
for Computer Science Instruction," *Proceedings of the 33rd Midwest Instruction and  
Computing Symposium (CD-ROM)*, April 14-15, 2000, Minneapolis, MN.

Dershem, H.L., Parker\*, D.E., and R. Weinhold\*, "A Java Function Visualizer," *Journal  
of Computing in Small Colleges*, 15,1(Oct, 1999), 221-230.

#### **Up to 5 other significant publications, whether or not related to the proposed project:**

Dershem, H.L. and J. Vanderhyde\*, "Java Class Visualization for Teaching Object-  
Oriented Concepts," *SIGCSE Bulletin*, 30,1(Mar, 1998), 53-57.

Dershem, H.L. and P. Brummund\*, "Tools for Web-Based Sorting Animation," *SIGCSE  
Bulletin*, 30,1(Mar, 1998), 222-226.

Dershem, H.L., Barth\*, W., Bowsher\*, C., and D. Brown\*, "Data Structures with Ada  
Packages, Laboratories, and Animations," *Proceedings of the First Australasian  
Conference on Computer Science Education*, July, 1996, 32-38.

Dershem, H.L. and M.J. Jipping, *Programming Languages: Models and Structures:  
Second Edition*, PWS Publishing Co., 1995.

McFall\*, R. and Dershem, "Finite State Machine Simulation in an Introductory Lab,"  
*SIGCSE Bulletin*, 26,1(Mar, 1994), 126-140.

***(iv) Synergistic Activities***

**a. Previous grants awarded:**

Co-director, "Introduction of the Computer in the Statistics Curriculum", NSF Office of Computing Activities, 1971-1973, \$45,800.

Director, "A Modular Approach to the Introductory Course in Computer Science", NSF Local Course Improvement Program, 1978-1980, \$14,200

Co-Director, "A Microcomputer Laboratory for use in Teaching Statistics", NSF Instructional Scientific Equipment Program, 1979-1980, \$10,315.

Director, "CSNET Membership in Support of Computer Science Research", NSF RUI Program, 1987-1990, \$9,375.

Director, "Computer Science Undergraduate Research Program", NSF REU Program, 1992-1994, \$86,550; 1995-1997, \$114,393; 1998-2000, \$146,700; 2001-2003, \$163,213, 2004-2008, \$352,000.

Director, "Use of Ada, Laboratories, and Visualization in the Teaching of Data Structures and Discrete Mathematics", DARPA Curriculum Development Grant, 1993- 1994, \$23,010.

Director, "Curriculum and Textbook Development Using Ada 9X for the Teaching of Object-Oriented Concepts", US Air Force Contract, 1995-1996, \$34,464.

Co-Director, "An Integrated Classroom/Laboratory for Introducing Students to Object Oriented Concepts", NSF ILI Program, 1996-1998, \$46,356.

Director, "Computer Science, Engineering, and Mathematics Scholarship Program", NSF CSEMS Program, 2005-2008, \$398,040.

Director, "Scholarships for Transfer Students in Science, Engineering, and Mathematics", NSF S-STEM Program, 2007-2012, \$564,360.

***(v) Collaborations and Other Affiliations***

**a. Collaborators and Co-Editors**

A list of scientists collaborated with on projects over the last 48 months would include:

Scott Grissom (Grand Valley State University), Michael Jipping (Hope College), Ryan McFall (Hope College), Myles McNally (Alma College), Thomas Naps (University of Wisconsin-Oshkosh), Samuel Rebelsky (Grinnell College), Henry Walker (Grinnell College).

**b. Graduate and Postdoctoral Advisors**

Robert E. Lynch (Purdue University)

**c. Thesis Advisor and Postgraduate-Scholar Sponsor**

None

## BIOGRAPHICAL SKETCH

Moses Lee

Dean for Natural and Applied Sciences (NAS) & Professor of Chemistry

### A. Professional Preparation:

B. Sc. (Honors) Biochemistry, University of Guelph, Guelph, Canada, 1983.

Ph.D. Organic Chemistry, University of Guelph, 1986.

Postdoctoral Associate, University of Alberta, Canada, 1986-1987.

### B. Appointments:

Dean for NAS Division & Professor of Chemistry, Hope College, 2005 – present

Adjunct Professor of Chemistry, Georgia State University, 2002 – present

Full Professor & Rose J. Forgione Chair of Chemistry, Furman University, 1998 – 2005

Camille and Henry Dreyfus Scholar, 2002 - 2005

Visiting Professor, University of Guelph, Guelph, Canada, 2002 - 2003

Visiting Associate Professor, National University of Singapore, 1995 -1996

Associate Professor of Chemistry, Furman University, 1994 - 1998

Henry Dreyfus Teacher - Scholar, 1994 - 1999

Henry and Ellen Townes Assistant Professor, 1992 - 1994

Assistant Professor of Chemistry, Furman University, 1989 – 1994

Research Scientist, Synphar Laboratories Inc., Edmonton, 1987 - 89

### C. Publications: (150 published and accepted)

(i) *Five Recent Publications (undergraduate co-workers are underlined)*

1. *Investigating the Effects of the N-Formamido Moiety on the Binding of Pyrrole- and Imidazole-Containing Triamides with their Cognate 5'-ACGCGT-3' Sequence.* L. Westrate, J.A. Sutterfield, R. Leblanc, T. Brown, Jerome Kluza, J. A. Hartley, B. Nguyen, D. Wilson and M. Lee, 2009, *Biochemistry* **48**, 5679–5688.

2. *Sequence Specific and High Affinity Recognition of 5'-ACGCGT-3' by a Rationally Designed Pyrrole-Imidazole H-pin Polyamide.* H. Mackay, T. Brown, P. B. Uthe, L. Westrate, A. Sielaff, J. P. Lajiness, J. Kluza, C. O'Hare, B. Nguyen, C. Bruce, W. D. Wilson, J. A. Hartley and M. Lee, *Bioorg. Med. Chem.* **2008**, *16*, 9145-9153.

3. *The Use of 2-Aminopurine-Cytosine Containing Oligonucleotides and Fluorescence Spectroscopy to Investigate DNA-Polyamide Binding.* A. Sielaff, H. Mackay, T. Brown and M. Lee, *Biophys. Biochem. Res. Commun.* **2008**, *369*, 630-634.

4. *Characterization of the DNA sequence selective adenine alkylation, mechanisms of adduct repair and in vivo antitumour activity of the novel achiral seco-amino-CBI analogue of duocarmycin AS-I-145.* K. Kiakos, A. Sato, T. Asao, P.J. McHugh, M. Lee, J.A. Hartley. *Molecular Cancer Therapeutics* **2007**, *6*, 2708-2718.

5. *DNA Interstrand Crosslinking Agents: Synthesis, DNA Interactions, and Cytotoxicity of Dimeric Achiral seco-amino-CBI and Conjugates of Achiral seco-Amino-CBI with Pyrrolobenzodiazepine (PBD).* B. Purnell, A. Sato, A. O'Kelley, C. Price, K. Summerville, S. Hudson, C. O'Hare, K. Kiakos, J. A. Hartley, T. Asao, M. Lee. *Bioorg. Med. Chem. Lett.* **2006**, *16*, 5677-5681.

6. *An Efficient Synthesis of an Achiral seco-cyclopropylhydroxybenz[2,3-e]indoline (CBI) Analog: Achiral seco-CBI-TMI.* A. Sato, A. Scott, S. Kim, T. Asao and M. Lee. *J. Org. Chem.* **2006**, *71*, 4692-4695.

(ii) **Books edited:** 2 [M. Lee, Ed. In *Topics of Heterocyclic Chemistry: Heterocyclic Antitumor, Antibiotics*. Springer, Berlin, 2006; and M Lee and L. Streckowski, Eds. In *Synthetic and Biophysical Studies of DNA binding Compounds*. Research Signpost. 2007.]

(iii) **Patents:** 4 since 1988 (1 this year).

(iv) **Presentations:** 173 total, 82 since 2002, all with student co-presenters. *Invited Talks:* 85 total, 53 since 2002.

#### **D. Synergistic Activities:**

- Consultant for Research Corporation Department Developmental Award Program, June 2004 – present.
- American Chemical Society PRF Advisory Board 2002 – 2008.
- Editorial Board of **Medicinal Chemistry** 2004 – present, **Heterocyclic Communications** 2002 – present, **The Open Cancer Journal** 2006 – present, **Current Bioactive Compounds** 2008 – present.
- NSF-NIH Workshop on Instrument Design, Washington, DC, 2008.
- Panel member for Academic Leadership Conference, Research Corporation, Az, 2004
- Co-organizer NSF Workshop Undergraduate Research Centers, Washington, DC, 2003.
- NSF-REU Leadership Group, 2001-2003
- Expert Consultant, Division of Chemistry, NSF, Arlington, VA, 2002 - 2003
- Steering Committee for Summit on Undergraduate Research 2002 – 2003
- Panelist: NSF-URC 2004, NSF-CAREER, 2000, 2001, NSF-ILI 1996, NSF-CRIF 2008
- Research Corporation Advisory Committee member, 1996-2000
- Member, American Chemical Society, and the American Association for Cancer Research
- Program Chair, Division of Medicinal Chemistry, SE Regional ACS Meeting, fall 2002
- Chair for organizing symposia on small molecule-DNA interactions, SE regional ACS meeting (October 1996 and November 2003), Wake Forest University (March 2001)
- Consultant: Spirogen (UK), 2001 – present, Taiho Pharmaceutical Co. (Japan), 1999 – 2005
- Milliken Company (SC), 2000 – 2002; Enzacta (UK), 1997 – 2000.
- Developed laboratory exercises for organic and biochemistry; *J. Chem. Ed.* and *Chemical Education Resources*.
- Review proposals for the NSF, ACS-PRF, Research Corporation, NC Biotech Center, Murdock Trust, Big C Cancer Research Fund.
- Reviewer of manuscripts for *Biochem.*, *Bioorg. Med. Chem.*, *Bioorg. Med. Chem. Lett.*, *Med. Chem.*, *Med. Chem. Res.*, *J. Am. Chem. Soc.*, *Chem. Commun.*, *J. Med. Chem.*, *J. Org. Chem.*, *Org. Lett.*, *J. Chem. Ed.*

#### **E. Collaborators and other Affiliations:**

(i) *Collaborators:* Professor John Hartley and Professor Daniel Hochhauser, Royal Free & University College Medical School, UK; Professor David Thurston and Dr. Phil Howard, University of London, School of Pharmacy, UK; Professor Terry Spithill, Charles Sturt University, Australia; Dr. Stephanie Yanow, Laboratory for Provincial Health, Alberta, Canada; Professor Armando Jardim, McGill U, Canada; Professor Hiroshi Sugiyama, U of Tokyo, Japan; Professor W. David Wilson, Georgia State University; Dr. Jerry Collins and Dr. Joe Covey at the National Cancer Institute, MD; Drs. Mike Walla and Bill Cotham, U of South Carolina, Columbia, SC; Professor Kim Opperman-Pacheco, U of Northern Colorado, CO; Professor Chrystal Bruce, Erskine College, SC; Professor Phil Bowen, UNC, Greensboro, NC; Professor Herman L. Holt, Jr. UNC, Asheville, NC; Professor Haizhen Zhang, U of Nebraska, Omaha.

(i) *Mentors:* Professor G.L. Lange (Ph.D. Advisor); Professor J.W. Lown (Postdoctoral Advisor)

(ii) *Postdoctoral Advisor (11 since 1990; 8 in last 6 years):* Drs. Natalie Brooks; Stephen Mayalarp; Sharon Jennings; Angela DiFrancesco; Atsushi Sato; Hari Pati, Karen Buchmueller, Toni Brown, Hilary Mackay; Sameer Chavda; Balaji Babu.

(iv) *Graduate Research/Thesis Advisor (M.S.) (32 since 1990; 24 in the last 9 years)*

(v) *Undergraduate Research/Thesis Advisor (228 since 1990; 146 in the last 9 years)*

# SUMMARY PROPOSAL BUDGET

YEAR 1

ORGANIZATION <b>Hope College</b>				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR <b>Catherine M Mader</b>				Proposed	Granted		
				AWARD NO.			
A. SENIOR PERSONNEL: PI/PI, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				NSF Funded Person-months		Funds Requested By proposer	Funds granted by NSF (if different)
	CAL	ACAD	SUMR				
1. <b>Catherine M Mader - Professor of Physics</b>	0.00	2.25	0.25	\$	<b>21,110</b>	\$	
2. <b>Herbert L Dershem - Professor of Computer Science</b>	0.00	0.00	0.00		<b>0</b>		
3. <b>Moses Lee - Dean, Nat. &amp; App. Science</b>	0.00	0.00	0.00		<b>0</b>		
4.							
5.							
6. ( <b>0</b> ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00		<b>0</b>		
7. ( <b>3</b> ) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	2.25	0.25		<b>21,110</b>		
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1. ( <b>0</b> ) POST DOCTORAL SCHOLARS	0.00	0.00	0.00		<b>0</b>		
2. ( <b>0</b> ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.00	0.00	0.00		<b>0</b>		
3. ( <b>0</b> ) GRADUATE STUDENTS					<b>0</b>		
4. ( <b>0</b> ) UNDERGRADUATE STUDENTS					<b>0</b>		
5. ( <b>0</b> ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					<b>0</b>		
6. ( <b>0</b> ) OTHER					<b>0</b>		
TOTAL SALARIES AND WAGES (A + B)					<b>21,110</b>		
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)					<b>3,831</b>		
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)					<b>24,941</b>		
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT					<b>0</b>		
E. TRAVEL					<b>1,000</b>		
1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					<b>1,000</b>		
2. FOREIGN					<b>0</b>		
F. PARTICIPANT SUPPORT COSTS							
1. STIPENDS	\$	<b>25,200</b>					
2. TRAVEL		<b>0</b>					
3. SUBSISTENCE		<b>0</b>					
4. OTHER		<b>5,428</b>					
TOTAL NUMBER OF PARTICIPANTS ( <b>14</b> )				TOTAL PARTICIPANT COSTS		<b>30,628</b>	
G. OTHER DIRECT COSTS							
1. MATERIALS AND SUPPLIES					<b>0</b>		
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION					<b>0</b>		
3. CONSULTANT SERVICES					<b>5,000</b>		
4. COMPUTER SERVICES					<b>0</b>		
5. SUBAWARDS					<b>0</b>		
6. OTHER					<b>0</b>		
TOTAL OTHER DIRECT COSTS					<b>5,000</b>		
H. TOTAL DIRECT COSTS (A THROUGH G)					<b>61,569</b>		
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)							
<b>10550 (Rate: 50.0000, Base: 21110) (Cont. on Comments Page)</b>							
TOTAL INDIRECT COSTS (F&A)					<b>16,855</b>		
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)					<b>78,424</b>		
K. RESIDUAL FUNDS					<b>0</b>		
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)					\$ <b>78,424</b>	\$	
M. COST SHARING PROPOSED LEVEL \$ <b>0</b>				AGREED LEVEL IF DIFFERENT \$			
PI/PI NAME <b>Catherine M Mader</b>				FOR NSF USE ONLY			
ORG. REP. NAME* <b>Tracey Nally</b>				INDIRECT COST RATE VERIFICATION			
		Date Checked		Date Of Rate Sheet		Initials - ORG	



## SUMMARY PROPOSAL BUDGET COMMENTS - Year 1

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**\*\* I- Indirect Costs  
6300 (Rate: 25.0000, Base 25200)**

# SUMMARY PROPOSAL BUDGET

YEAR **2**

ORGANIZATION <b>Hope College</b>				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR <b>Catherine M Mader</b>				Proposed	Granted		
				AWARD NO.			
A. SENIOR PERSONNEL: PI/PI, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				NSF Funded Person-months		Funds Requested By proposer	Funds granted by NSF (if different)
				CAL	ACAD	SUMR	
1. <b>Catherine M Mader - Professor of Physics</b>				0.00	1.80	0.25	\$ <b>18,130</b>
2. <b>Herbert L Dershem - Professor of Computer Science</b>				0.00	0.00	0.00	<b>0</b>
3. <b>Moses Lee - Dean, Nat. &amp; App. Science</b>				0.00	0.00	0.00	<b>0</b>
4.							
5.							
6. ( <b>0</b> ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)				0.00	0.00	0.00	<b>0</b>
7. ( <b>3</b> ) TOTAL SENIOR PERSONNEL (1 - 6)				0.00	1.80	0.25	<b>18,130</b>
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1. ( <b>0</b> ) POST DOCTORAL SCHOLARS				0.00	0.00	0.00	<b>0</b>
2. ( <b>0</b> ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)				0.00	0.00	0.00	<b>0</b>
3. ( <b>0</b> ) GRADUATE STUDENTS							<b>0</b>
4. ( <b>0</b> ) UNDERGRADUATE STUDENTS							<b>0</b>
5. ( <b>0</b> ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)							<b>0</b>
6. ( <b>0</b> ) OTHER							<b>0</b>
TOTAL SALARIES AND WAGES (A + B)							<b>18,130</b>
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)							<b>3,291</b>
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)							<b>21,421</b>
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT							<b>0</b>
E. TRAVEL							<b>1,000</b>
1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)							<b>1,000</b>
2. FOREIGN							<b>0</b>
F. PARTICIPANT SUPPORT COSTS							
1. STIPENDS \$ <b>47,070</b>							
2. TRAVEL <b>0</b>							
3. SUBSISTENCE <b>0</b>							
4. OTHER <b>10,825</b>							
TOTAL NUMBER OF PARTICIPANTS ( <b>28</b> )							
TOTAL PARTICIPANT COSTS							<b>57,895</b>
G. OTHER DIRECT COSTS							
1. MATERIALS AND SUPPLIES							<b>0</b>
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION							<b>0</b>
3. CONSULTANT SERVICES							<b>5,000</b>
4. COMPUTER SERVICES							<b>0</b>
5. SUBAWARDS							<b>0</b>
6. OTHER							<b>0</b>
TOTAL OTHER DIRECT COSTS							<b>5,000</b>
H. TOTAL DIRECT COSTS (A THROUGH G)							<b>85,316</b>
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)							
<b>11768 (Rate: 25.0000, Base: 47070) (Cont. on Comments Page)</b>							
TOTAL INDIRECT COSTS (F&A)							<b>20,833</b>
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)							<b>106,149</b>
K. RESIDUAL FUNDS							<b>0</b>
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)							\$ <b>106,149</b> \$
M. COST SHARING PROPOSED LEVEL \$ <b>0</b>				AGREED LEVEL IF DIFFERENT \$			
PI/PI NAME <b>Catherine M Mader</b>				FOR NSF USE ONLY			
ORG. REP. NAME* <b>Tracey Nally</b>				INDIRECT COST RATE VERIFICATION			
		Date Checked		Date Of Rate Sheet		Initials - ORG	

## SUMMARY PROPOSAL BUDGET COMMENTS - Year 2

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**\*\* I- Indirect Costs  
9065 (Rate: 50.0000, Base 18130)**

# SUMMARY PROPOSAL BUDGET

YEAR 3

ORGANIZATION <b>Hope College</b>				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR <b>Catherine M Mader</b>				AWARD NO.	Proposed	Granted	
A. SENIOR PERSONNEL: PI/PI, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				NSF Funded Person-months		Funds Requested By proposer	Funds granted by NSF (if different)
		CAL	ACAD	SUMR			
1.	<b>Catherine M Mader - Professor of Physics</b>	0.00	1.50	0.25	\$ 16,215	\$	
2.	<b>Herbert L Dershem - Professor of Computer Science</b>	0.00	0.00	0.00	0		
3.	<b>Moses Lee - Dean, Nat. &amp; App. Science</b>	0.00	0.00	0.00	0		
4.							
5.							
6.	( 0 ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	0		
7.	( 3 ) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	1.50	0.25	16,215		
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1.	( 0 ) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	0		
2.	( 0 ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.00	0.00	0.00	0		
3.	( 0 ) GRADUATE STUDENTS				0		
4.	( 0 ) UNDERGRADUATE STUDENTS				0		
5.	( 0 ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0		
6.	( 0 ) OTHER				0		
TOTAL SALARIES AND WAGES (A + B)					16,215		
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)					2,943		
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)					19,158		
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT					0		
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					1,000		
2. FOREIGN					0		
F. PARTICIPANT SUPPORT COSTS							
1.	STIPENDS \$ <b>48,490</b>						
2.	TRAVEL <b>0</b>						
3.	SUBSISTENCE <b>0</b>						
4.	OTHER <b>11,129</b>						
TOTAL NUMBER OF PARTICIPANTS ( 28 )				TOTAL PARTICIPANT COSTS	59,619		
G. OTHER DIRECT COSTS							
1. MATERIALS AND SUPPLIES					0		
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION					0		
3. CONSULTANT SERVICES					5,000		
4. COMPUTER SERVICES					0		
5. SUBAWARDS					0		
6. OTHER					0		
TOTAL OTHER DIRECT COSTS					5,000		
H. TOTAL DIRECT COSTS (A THROUGH G)					84,777		
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) <b>12122 (Rate: 25.0000, Base: 48490) (Cont. on Comments Page)</b>							
TOTAL INDIRECT COSTS (F&A)					20,231		
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)					105,008		
K. RESIDUAL FUNDS					0		
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)					\$ 105,008	\$	
M. COST SHARING PROPOSED LEVEL \$ <b>0</b>				AGREED LEVEL IF DIFFERENT \$			
PI/PI NAME <b>Catherine M Mader</b>				FOR NSF USE ONLY			
ORG. REP. NAME* <b>Tracey Nally</b>				INDIRECT COST RATE VERIFICATION			
		Date Checked	Date Of Rate Sheet	Initials - ORG			

## SUMMARY PROPOSAL BUDGET COMMENTS - Year 3

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**\*\* I- Indirect Costs  
8108 (Rate: 50.0000, Base 16215)**

# SUMMARY PROPOSAL BUDGET

YEAR 4

ORGANIZATION <b>Hope College</b>				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR <b>Catherine M Mader</b>				Proposed	Granted		
				AWARD NO.			
A. SENIOR PERSONNEL: PI/PI, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				NSF Funded Person-months		Funds Requested By proposer	Funds granted by NSF (if different)
				CAL	ACAD	SUMR	
1. <b>Catherine M Mader - Professor of Physics</b>				0.00	1.29	0.25	\$ <b>14,900</b>
2. <b>Herbert L Dershem - Professor of Computer Science</b>				0.00	0.00	0.00	<b>0</b>
3. <b>Moses Lee - Dean, Nat. &amp; App. Science</b>				0.00	0.00	0.00	<b>0</b>
4.							
5.							
6. ( <b>0</b> ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)				0.00	0.00	0.00	<b>0</b>
7. ( <b>3</b> ) TOTAL SENIOR PERSONNEL (1 - 6)				0.00	1.29	0.25	<b>14,900</b>
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1. ( <b>0</b> ) POST DOCTORAL SCHOLARS				0.00	0.00	0.00	<b>0</b>
2. ( <b>0</b> ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)				0.00	0.00	0.00	<b>0</b>
3. ( <b>0</b> ) GRADUATE STUDENTS							<b>0</b>
4. ( <b>0</b> ) UNDERGRADUATE STUDENTS							<b>0</b>
5. ( <b>0</b> ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)							<b>0</b>
6. ( <b>0</b> ) OTHER							<b>0</b>
TOTAL SALARIES AND WAGES (A + B)							<b>14,900</b>
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)							<b>2,704</b>
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)							<b>17,604</b>
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT							<b>0</b>
E. TRAVEL							<b>1,000</b>
1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)							<b>1,000</b>
2. FOREIGN							<b>0</b>
F. PARTICIPANT SUPPORT COSTS							
1. STIPENDS \$ <b>49,910</b>							
2. TRAVEL <b>0</b>							
3. SUBSISTENCE <b>0</b>							
4. OTHER <b>11,462</b>							
TOTAL NUMBER OF PARTICIPANTS ( <b>28</b> )							
TOTAL PARTICIPANT COSTS							<b>61,372</b>
G. OTHER DIRECT COSTS							
1. MATERIALS AND SUPPLIES							<b>0</b>
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION							<b>0</b>
3. CONSULTANT SERVICES							<b>5,000</b>
4. COMPUTER SERVICES							<b>0</b>
5. SUBAWARDS							<b>0</b>
6. OTHER							<b>0</b>
TOTAL OTHER DIRECT COSTS							<b>5,000</b>
H. TOTAL DIRECT COSTS (A THROUGH G)							<b>84,976</b>
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)							
<b>12478 (Rate: 25.0000, Base: 49910) (Cont. on Comments Page)</b>							
TOTAL INDIRECT COSTS (F&A)							<b>19,928</b>
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)							<b>104,904</b>
K. RESIDUAL FUNDS							<b>0</b>
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)							\$ <b>104,904</b> \$
M. COST SHARING PROPOSED LEVEL \$ <b>0</b>				AGREED LEVEL IF DIFFERENT \$			
PI/PI NAME <b>Catherine M Mader</b>				FOR NSF USE ONLY			
ORG. REP. NAME* <b>Tracey Nally</b>				INDIRECT COST RATE VERIFICATION			
		Date Checked		Date Of Rate Sheet		Initials - ORG	

## SUMMARY PROPOSAL BUDGET COMMENTS - Year 4

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**\*\* I- Indirect Costs  
7450 (Rate: 50.0000, Base 14900)**

# SUMMARY PROPOSAL BUDGET

YEAR 5

ORGANIZATION <b>Hope College</b>				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR <b>Catherine M Mader</b>				AWARD NO.	Proposed	Granted	
A. SENIOR PERSONNEL: PI/PI, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				NSF Funded Person-months		Funds Requested By proposer	Funds granted by NSF (if different)
				CAL	ACAD	SUMR	
1.	<b>Catherine M Mader - Professor of Physics</b>			0.00	1.13	0.25	\$ <b>13,945</b>
2.	<b>Herbert L Dershem - Professor of Computer Science</b>			0.00	0.00	0.00	<b>0</b>
3.	<b>Moses Lee - Dean, Nat. &amp; App. Science</b>			0.00	0.00	0.00	<b>0</b>
4.							
5.							
6.	( 0 ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)			0.00	0.00	0.00	<b>0</b>
7.	( 3 ) TOTAL SENIOR PERSONNEL (1 - 6)			0.00	1.13	0.25	<b>13,945</b>
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1.	( 0 ) POST DOCTORAL SCHOLARS			0.00	0.00	0.00	<b>0</b>
2.	( 0 ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)			0.00	0.00	0.00	<b>0</b>
3.	( 0 ) GRADUATE STUDENTS						<b>0</b>
4.	( 0 ) UNDERGRADUATE STUDENTS						<b>0</b>
5.	( 0 ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)						<b>0</b>
6.	( 0 ) OTHER						<b>0</b>
TOTAL SALARIES AND WAGES (A + B)							<b>13,945</b>
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)							<b>2,531</b>
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)							<b>16,476</b>
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT							<b>0</b>
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)							<b>1,000</b>
2. FOREIGN							<b>0</b>
F. PARTICIPANT SUPPORT COSTS							
1.	STIPENDS	\$	<b>51,400</b>				
2.	TRAVEL		<b>0</b>				
3.	SUBSISTENCE		<b>0</b>				
4.	OTHER		<b>11,803</b>				
TOTAL NUMBER OF PARTICIPANTS ( 28 )				TOTAL PARTICIPANT COSTS			<b>63,203</b>
G. OTHER DIRECT COSTS							
1.	MATERIALS AND SUPPLIES						<b>0</b>
2.	PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION						<b>0</b>
3.	CONSULTANT SERVICES						<b>5,000</b>
4.	COMPUTER SERVICES						<b>0</b>
5.	SUBAWARDS						<b>0</b>
6.	OTHER						<b>0</b>
TOTAL OTHER DIRECT COSTS							<b>5,000</b>
H. TOTAL DIRECT COSTS (A THROUGH G)							<b>85,679</b>
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) <b>12850 (Rate: 25.0000, Base: 51400) (Cont. on Comments Page)</b>							
TOTAL INDIRECT COSTS (F&A)							<b>19,823</b>
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)							<b>105,502</b>
K. RESIDUAL FUNDS							<b>0</b>
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)							\$ <b>105,502</b> \$
M. COST SHARING PROPOSED LEVEL \$ <b>0</b>				AGREED LEVEL IF DIFFERENT \$			
PI/PI NAME <b>Catherine M Mader</b>				FOR NSF USE ONLY			
ORG. REP. NAME* <b>Tracey Nally</b>				INDIRECT COST RATE VERIFICATION			
		Date Checked	Date Of Rate Sheet	Initials - ORG			



## SUMMARY PROPOSAL BUDGET COMMENTS - Year 5

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**\*\* I- Indirect Costs  
6973 (Rate: 50.0000, Base 13945)**

# SUMMARY PROPOSAL BUDGET

Cumulative

ORGANIZATION <b>Hope College</b>				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR <b>Catherine M Mader</b>				Proposed	Granted		
				AWARD NO.			
A. SENIOR PERSONNEL: PI/PI, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				NSF Funded Person-months		Funds Requested By proposer	Funds granted by NSF (if different)
				CAL	ACAD	SUMR	
1. <b>Catherine M Mader - Professor of Physics</b>				0.00	7.97	1.25	\$ <b>84,300</b>
2. <b>Herbert L Dershem - Professor of Computer Science</b>				0.00	0.00	0.00	<b>0</b>
3. <b>Moses Lee - Dean, Nat. &amp; App. Science</b>				0.00	0.00	0.00	<b>0</b>
4.							
5.							
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)				0.00	0.00	0.00	<b>0</b>
7. ( <b>3</b> ) TOTAL SENIOR PERSONNEL (1 - 6)				0.00	7.97	1.25	<b>84,300</b>
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1. ( <b>0</b> ) POST DOCTORAL SCHOLARS				0.00	0.00	0.00	<b>0</b>
2. ( <b>0</b> ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)				0.00	0.00	0.00	<b>0</b>
3. ( <b>0</b> ) GRADUATE STUDENTS							<b>0</b>
4. ( <b>0</b> ) UNDERGRADUATE STUDENTS							<b>0</b>
5. ( <b>0</b> ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)							<b>0</b>
6. ( <b>0</b> ) OTHER							<b>0</b>
TOTAL SALARIES AND WAGES (A + B)							<b>84,300</b>
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)							<b>15,300</b>
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)							<b>99,600</b>
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT							<b>0</b>
E. TRAVEL							<b>5,000</b>
1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)							<b>5,000</b>
2. FOREIGN							<b>0</b>
F. PARTICIPANT SUPPORT COSTS							
1. STIPENDS \$ <u>222,070</u>							
2. TRAVEL <u>0</u>							
3. SUBSISTENCE <u>0</u>							
4. OTHER <u>50,647</u>							
TOTAL NUMBER OF PARTICIPANTS ( <b>126</b> )							
TOTAL PARTICIPANT COSTS							<b>272,717</b>
G. OTHER DIRECT COSTS							
1. MATERIALS AND SUPPLIES							<b>0</b>
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION							<b>0</b>
3. CONSULTANT SERVICES							<b>25,000</b>
4. COMPUTER SERVICES							<b>0</b>
5. SUBAWARDS							<b>0</b>
6. OTHER							<b>0</b>
TOTAL OTHER DIRECT COSTS							<b>25,000</b>
H. TOTAL DIRECT COSTS (A THROUGH G)							<b>402,317</b>
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)							
TOTAL INDIRECT COSTS (F&A)							<b>97,670</b>
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)							<b>499,987</b>
K. RESIDUAL FUNDS							<b>0</b>
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)							\$ <b>499,987</b> \$
M. COST SHARING PROPOSED LEVEL \$ <b>0</b>				AGREED LEVEL IF DIFFERENT \$			
PI/PI NAME <b>Catherine M Mader</b>				FOR NSF USE ONLY			
ORG. REP. NAME* <b>Tracey Nally</b>				INDIRECT COST RATE VERIFICATION			
		Date Checked		Date Of Rate Sheet		Initials - ORG	

C \*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

## 5 Year Budget Justification

### **A1. Senior Personnel = \$84,300**

PI is supported for two weeks/summer/year to organize meetings with the advisory committees and administering the summer research program. In addition, the PI will work ¼-time during the first academic year coordinating and administrating the program. Time commitment of the PI will decrease to 1/8-time by year 5 as several aspects of the program become integrated into existing programs. The requested academic year salary is less than the PIs contracted salary.

### **C. Fringe Benefits = \$15,300**

The rate of 18.15% is requested for senior personnel which covers 6.20% FICA +1.45% MQFE +10.5% retirement.

### **E. Travel = \$5,000**

Travel for both the PI and one co PI to attend the annual STEP Principal Investigators meeting is budgeted at \$1,000/year. However, it is expected to cost twice that amount (\$2000/yr). *The additional \$5,000 travel expenses will be paid by the college.*

### **F. Participant Support Costs = \$272,717**

#### **F1 Stipends - \$222,070**

70 STEM Scholars (14 each summer) will be supported for five weeks as rising freshman at \$360/week with a 3% incremental increase in years 2-5. 56 continuing STEM Scholars (14 each summer beginning in year 2) will be supported as rising sophomores for ten weeks at \$422/week with a 3% incremental increase in years 3-5. 36 of these STEM scholars will be supported by existing Hope College programs. Thus funding for only 20 continuing Scholars is requested.

#### **F4 Other - \$50,647**

Supplies of \$250/Scholar/year is budgeted for research projects with a 3% incremental increase/Scholar/year. **FICA and MQFE** at the rate of 7.65% are requested for student salaries.

### **G3. Consultant Services = \$25,000**

Project assessment and evaluation will be carried out by the Frost Center for Social Science Research at Hope College. This is budgeted at \$1,000/year. In addition, travel support for the three member external advisory team is budgeted at \$4,000/year and is included in this category.

### **H. Indirect costs = \$97,670**

Indirect costs are calculated at 50% of senior personal salaries and 25% of participant stipends.

### **Hope College Contribution = \$176,171**

As mentioned above, the college will contribute the additional support needed for the PI and a co- PI to travel to the annual PI meeting in Washington DC. It is expected that this will be a \$1000/year commitment by the College over 5 years of the grant.

The departments of Biology, Chemistry, Computer Science, Engineering, Geology and Environmental Science, Mathematics, and Physics, the Dean for Natural and Applied Sciences and the director of the HHMI-funded STEM initiative at Hope College have each committed to supporting one continuing STEM Scholar during the summer between their Freshman and Sophomore years at Hope College. This institutional commitment to support 9 of the 14 continuing Scholars amounts to \$171,171 in salary support and effectively reduces the total budget by over \$200,000 due to the reduced overhead costs associated with this grant request.

## Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.	
Investigator: Catherine Mader	Other agencies (including NSF) to which this proposal has been/will be submitted.
Support: <input checked="" type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title: Nuclear Forensics Workshops  Source of Support: American Institute of Physics Meggers Award Total Award Amount: \$ 8,000 Total Award Period Covered: 08/31/09 - 08/31/10 Location of Project: Hope College Person-Months Per Year Committed to the Project. Cal:0.50 Acad:0.00 Sumr: 0.00	
Support: <input checked="" type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title: Research Experiences for Undergraduates in Physics and Engineering at Hope College  Source of Support: NSF - REU Total Award Amount: \$ 306,638 Total Award Period Covered: 02/01/05 - 01/31/10 Location of Project: Hope College Person-Months Per Year Committed to the Project. Cal:0.50 Acad:0.00 Sumr: 0.00	
Support: <input checked="" type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title: Physics REU Directors' Workshop  Source of Support: NSF Total Award Amount: \$ 76,358 Total Award Period Covered: 05/01/08 - 04/30/10 Location of Project: American Physical Society Person-Months Per Year Committed to the Project. Cal:0.50 Acad:0.00 Sumr: 0.00	
Support: <input type="checkbox"/> Current <input checked="" type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title: Providing STEM Research Infrastructure for VanderWerf Hall at Hope College  Source of Support: NSF Total Award Amount: \$ 518,516 Total Award Period Covered: 03/01/10 - 02/28/13 Location of Project: Hope College Person-Months Per Year Committed to the Project. Cal:0.00 Acad:1.00 Sumr: 0.50	
Support: <input type="checkbox"/> Current <input checked="" type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title: Scholarships to support the Hope STEM Scholars Program participants  Source of Support: NSF Total Award Amount: \$ 599,835 Total Award Period Covered: 02/01/10-02/01/15 Location of Project: Hope College Person-Months Per Year Committed to the Project. Cal:0.00 Acad:0.00 Summ: 0.25	
*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.	

## Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.	
Investigator: Catherine Mader	Other agencies (including NSF) to which this proposal has been/will be submitted.
Support: <input type="checkbox"/> Current <input checked="" type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title:    Creating the Hope STEM Scholars Program	
Source of Support:    NSF - STEP Total Award Amount: \$    499,987    Total Award Period Covered:    03/01/10 - 03/01/15 Location of Project:    Hope College Person-Months Per Year Committed to the Project.    Cal:0.00    Acad: 2.25    Sumr: 0.25	
Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title:	
Source of Support: Total Award Amount: \$                      Total Award Period Covered: Location of Project: Person-Months Per Year Committed to the Project.    Cal:              Acad:              Sumr:	
Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title:	
Source of Support: Total Award Amount: \$                      Total Award Period Covered: Location of Project: Person-Months Per Year Committed to the Project.    Cal:              Acad:              Sumr:	
Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title:	
Source of Support: Total Award Amount: \$                      Total Award Period Covered: Location of Project: Person-Months Per Year Committed to the Project.    Cal:              Acad:              Sumr:	
Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title:	
Source of Support: Total Award Amount: \$                      Total Award Period Covered: Location of Project: Person-Months Per Year Committed to the Project.    Cal:              Acad:              Summ:	

\*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

## Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.	
Investigator: Herbert Dershem	Other agencies (including NSF) to which this proposal has been/will be submitted.
<p>Support:    <input type="checkbox"/> Current    <input checked="" type="checkbox"/> Pending    <input type="checkbox"/> Submission Planned in Near Future    <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title:    Scholarships to support the Hope STEM Scholars Program participants</p> <p>Source of Support:    National Science Foundation - S-STEM</p> <p>Total Award Amount: \$    599,835 Total Award Period Covered:    02/01/10 - 01/31/15</p> <p>Location of Project:    Hope College</p> <p>Person-Months Per Year Committed to the Project.    Cal:0.00    Acad: 0.00    Sumr: 0.00</p>	
<p>Support:    <input checked="" type="checkbox"/> Current    <input type="checkbox"/> Pending    <input type="checkbox"/> Submission Planned in Near Future    <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title:    Scholarships for Transfer Students in Science, Engineering, and Mathematics</p> <p>Source of Support:    National Science Foundation - S-STEM</p> <p>Total Award Amount: \$    564,360 Total Award Period Covered:    09/01/07 - 08/31/12</p> <p>Location of Project:    Hope College</p> <p>Person-Months Per Year Committed to the Project.    Cal:0.00    Acad: 0.00    Sumr: 0.50</p>	
<p>Support:    <input checked="" type="checkbox"/> Current    <input type="checkbox"/> Pending    <input type="checkbox"/> Submission Planned in Near Future    <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title:    CSEMS Scholarship Program in Computer Science, Engineering, and Mathematics at Hope College</p> <p>Source of Support:    National Science Foundation - CSEMS</p> <p>Total Award Amount: \$    398,040 Total Award Period Covered:    08/01/04 - 05/31/10</p> <p>Location of Project:    Hope College</p> <p>Person-Months Per Year Committed to the Project.    Cal:0.00    Acad: 0.00    Sumr: 0.00</p>	
<p>Support:    <input type="checkbox"/> Current    <input checked="" type="checkbox"/> Pending    <input type="checkbox"/> Submission Planned in Near Future    <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title:    Creating the Hope STEM Scholars Program</p> <p>Source of Support: NSF STEP</p> <p>Total Award Amount: \$499,987    Total Award Period Covered: 03/01/10 - 03/01/15</p> <p>Location of Project: Hope College</p> <p>Person-Months Per Year Committed to the Project.    Cal:0    Acad:0    Sumr:0</p>	
<p>Support:    <input type="checkbox"/> Current    <input type="checkbox"/> Pending    <input type="checkbox"/> Submission Planned in Near Future    <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title:</p> <p>Source of Support:</p> <p>Total Award Amount: \$    Total Award Period Covered:</p> <p>Location of Project:</p> <p>Person-Months Per Year Committed to the Project.    Cal:    Acad:    Summ:</p>	
*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.	



## 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:** The STEM Departments occupy over 100,000 sq. ft. of space in the A. Paul Schaap Science Center and VanderWerf Hall. These buildings house over 25 teaching laboratories and 35 research laboratories. Many teaching laboratories are utilized by research groups in the summer to expand capabilities.

**Clinical:**

**Animal:** Greenhouse, mammal, aquatic and aviary facilities are housed in the Schaap Science Center. Animal research is regulated by an Animal Care and Use Committee that insures all research involving animals is in full compliance with all federal guidelines. Hope College has filed an Animal Welfare Assurance Document (AWA No. A3971- 01) with the PublicHealth Service.

**Computer:** Schaap Science Center and VanderWerf Hall have five general-use computer labs, a dedicated Geographic Information System lab, and a 16-station 100-parallel CPU supercomputer facility. In total, over 360 computers are available in laboratories for research and coursework.

**Office:**

**Other:** Hope College owns a 55-acre nature preserve 5 miles from campus and has access to a 120-acre private nature preserve with laboratory facilities, also within 5 miles of campus, and with which the college has a cooperative research & teaching agreement.

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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.

The science and engineering programs have very well equipped research and teaching laboratories which support over 40 different experimental research programs. Due to the close proximity and collegial nature of the small school, these research programs share many major resources.

-2 low-background Ortec HPGe gamma-ray counting facilities

-2 400 MHz high-field Varian NMR's

-CITL Cathodoluminescence system with stereomicroscope and UV-Vis spectrometer

-Perkin-Elmer inductively-coupled plasma -optical emission spectrometer

-NEC 1.7 MV Tandem Pelletron Accelerator and nuclear microprobe

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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.

The seven STEM departments are assisted by 3.5 FTE secretaries. In addition, the departments are assisted by 3 FTE laboratory directors, a full-time machine and electronics technician, various departmental student workers, a computer information technology center for computer assistance, and one large division-wide stockroom. One full-time person maintains and operates the computational and modeling facility.

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## FACILITIES, EQUIPMENT & OTHER RESOURCES

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Continuation Page:

MAJOR EQUIPMENT (continued):

- Cepheid Real-time PCR
- Agilent gas chromatograph - mass spectrometer
- 5 Agilent High Performance Liquid Chromatography systems
- Agilent HPLC - mass spectrometer
- Agilent 1100 series LC-MSD with auto sampler and diode array, APCI and electrospray detection
- Agilent 8453 Diode Array UV-VIS Spectrometer with standard and biochemical/kinetics software
- 4 Varian SpectraAA-50 Atomic Absorption Spectrometers
- Cary 5E UV-Vis spectrometer
- Hewlett Packard Series 1050 HPLC System with ternary solvent system and variable wavelength detector
- Hitachi powder X-ray diffractometer
- Agilent/HP 8566B 22 GHz spectrum analyzer
- Agilent/HP 8719C vector network analyzer
- Agilent/HP 8757C scalar network analyzer
- Agilent/HP 8350B sweep oscillator
- Agilent E4421B 3 GHz signal generator
- Rhode & Schwarz SMB100A 6 GHz signal generator
- Agilent 8648C 3.2 GHz signal generator
- Amplifier Research 5S1G4 0.8 to 4.2 GHz power amplifier
- Microwave Power, Inc. L0505-41-T533 5 GHz Power amplifier
- Agilent/HP E3631A triple output power supply
- Lindberg tube furnace and controller
- K&S 4523 K&S deep access wire bonder
- 2 Lakeshore 330 auto-tuning temperature controllers
- Lakeshore 321 autotuning temperature controller
- 3 Aisin TAC101JG helium refrigerator compressors
- 3 CTI M22 Gifford-McMahon cold heads
- 2 Cryo Industries of America custom liquid nitrogen cryostats
- Terra Universal Glove box
- 2 Hewlett Packard 6890A capillary gas chromatography systems
- LiCor Leaf Area Meter
- 2 Li-Cor LI-6400 portable photosynthesis systems
- CH Instruments Electrochemical Analyzer with EQCM Oscillator
- CH Instruments Model 602A Electrochemical Analyzer / Potentiostat with computer interface
- ESA Coulochem III for HPLC with Electrochemical Detection
- 3 Decagon AccuPAR light ceptometers
- MARS5 microwave-assisted digestion apparatus
- 2 Hitachi fluorometers
- Leica DM5000b combined brightfield (DIC) darkfield and fluorescent microscope
- 12 polarized light microscopes
- Nikon SMZ-2B reflecting light microscope
- Bausch&Lomb StereoZoom4 reflecting microscope
- Leica GZ6 reflecting microscope
- Solid Phase Peptide Synthesizer research instrument
- Branson 2510 ultrasonic cleaner
- Zeiss Axiovert 200 Fluorescence Microscope with Apotome Slider Assembly
- 4 Conviron E-15 controlled carbon dioxide growth chambers
- 2 two computerized stereotaxic surgery systems
- PX2 Thermal Cycler
- high resolution digital camera for tissue analysis of in situ hybridization and immunocytochemistry
- Leica CM1850 cryostat
- Respirationics temperature telemetry system
- Columbus Instruments Oxymax system