

## **HHMI Draft**

### ***Executive Summary (5000 characters)***

Student-faculty research has been an important element of the Eckerd College experience from the college's inception. Student-faculty research efforts are productive, thus it is a competitive process for students to be selected. As part of our research history, the *Natural Sciences Summer Research Program* (NSSRP) was established in 1991 from our first HHMI funds. Since then we have had a significant summer research program for science students in the fields of marine science, environmental studies, biology, chemistry, physics, computer science and mathematics. We would like to take the opportunity with this proposal to expand our goals with our summer research program. We will expand our program to include first year students and secondary school teachers. We also will join the *Survey of Undergraduate Research Experiences* (SURE) study so that we can help assess the long term value of these research opportunities.

Another aim of this proposal is to formally increase Eckerd College's role in producing motivated secondary education science teachers in the southeastern United States while at the same time strengthening our commitments with local institutions. A year-long education seminar program will be created for junior and senior science majors who aspire to be teachers. The seminar's primary component is a teaching practicum at two secondary institutions located close to the college. One of these institutions, Academy Prep (grades 5-8), serves the local area of southern St. Petersburg where a majority of the residents do not graduate from high school. Academy Prep has, since 1997, been "breaking the cycle, one child at a time". The second institution, Canterbury School (grades K-12), has an emphasis in marine science which is one of Eckerd College's largest majors. We are proud to invite these two institutions to this pilot program which will celebrate the teaching profession for our motivated students. An integral part of the relationship will be when students and teachers from these two institutions visit Eckerd College to participate in a variety of workshops and research during the summer months.

At Eckerd College we have three faculty members who are active in science education research and specifically develop computational modeling modules. These faculty work in the fields of marine geology and physics and use common and readily available software to produce these learning tools. As part of this proposal we secure resources to allow them to develop modeling packages, in collaboration with their life science colleagues, which will then be made available to the global life science community for use in the classroom or laboratory. These three science education researchers are also part of a quorum of campus leaders who engage in the research and practice of active learning pedagogies in the classroom. We would like to augment this interdisciplinary group with a new hire in biology science education. This biologist would be hired to have an active research program, co-run the secondary teaching seminar, and participate in the development of workshops and discussions on active learning approaches for the benefit of the Eckerd science faculty.

To increase the natural interaction between biology and mathematics disciplines we propose an interdisciplinary tenure track hire who will belong to both disciplines. This has been done with physics and mathematics recently and it has benefited both. This new hire will, depending on their expertise, strengthen our bio-informatics, computer modeling, or molecular biology courses. Perhaps more importantly she or he will serve as a role model for our aspiring quantitative and computational biologists. This proposal also aims to strengthen Eckerd College's mathematical and computational science curriculum for our life science students by strengthening the computational science minor, by developing internship possibilities in the Tampa Bay area for biologists interested in computational biology, and by the inclusion of more computational modeling curricula in their classrooms.

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## **Component Summary (3500 characters per component)**

### **1. Student Research and Broadening Access to Science (3500 characters) -- Dayton, Grove**

*(1) increase in Eckerd student stipends -  $\$25,000 \times 4 \text{ years} = \$100,000$*

*(2) increase in supply budget -  $\$10,000 \times 4 \text{ years} = \$40,000$*

*(3) increase in faculty stipend -  $\$10,000 \times 4 \text{ years} = \$40,000$*

*These costs will be picked up by Eckerd College after the grant funding is over ( $\$45,000$  per year)*

The Natural Sciences Summer Research Program (NSSRP) was established in 1991 from HHMI funds. We now average about 20 students annually who carry out research with faculty members under the auspices of the NSSRP. Since 2000 we have averaged 23 students per summer (ranging from 19 – 37), and sponsored a total of 187 undergraduates who conducted research with faculty members. Within that time period Eckerd College has added \$15,000 to the Program's budget, bringing the total to about \$60,000. These students are fully supported by NSSRP, i.e., they receive \$2,500 stipends + free housing in summer. Student research projects are of high quality and represent diverse interests; they lead to Senior Thesis research, presentations at professional meetings with their faculty supervisor, publications in peer-reviewed journals and presentations at Eckerd's regularly scheduled symposia in several science disciplines. We want to increase the participant stipend in an effort to remain competitive with other programs that are available to motivated, qualified students. More than 90% of Eckerd's students receive some form of financial aid; hence, their summer support is significant to them. Therefore, beginning in year one and continuing throughout the HHMI grant period, we propose to increase the NSSRP stipend from \$2,500 to \$3,500. Eckerd College commits to maintaining the increased summer research funding level beginning with the summer of 2013.

While we are satisfied with the overall quality of experience our students receive as participants in the NSSRP, it is our desire to increase the student stipend to \$3,500, in an effort to remain competitive with other programs around the country. And while we have a culture of active student participation in research and significant attendance at a variety of professional meetings, we believe we need to do more to celebrate the research accomplishments of our students within the Eckerd College community. We therefore request funds that would permit the establishment of an Eckerd College Undergraduate Research Symposium. The symposium will provide opportunities for undergraduate students engaged in research in all areas of science, the social sciences, and

the humanities to present their work in poster and oral formats, and would feature a keynote speaker in each of the three areas mentioned. This forum will be held in conjunction with Eckerd College's Sigma Xi chapter, an organization that promotes both campus and public participation. Sigma Xi events bring science and non-science audiences to the campus, and we feel that the experience of detailing one's work to a mixed audience is a vital aspect of science literacy in the community.

We would also like to augment our traditional research team of faculty member and student with more options for our incoming freshmen. Our goal for placing incoming freshmen with a declared interest in science into the research lab in the summer prior to their matriculation will be to provide them with a team experience that offers mentoring from upper level undergraduates and faculty members. This summer research program also includes outreach to secondary schools and assessment components which are discussed in later sections.

## **2. New, Current, and Future Faculty Development (3500 characters)**

*(1) 2 faculty hires (salary and fringe) : \$250,000 x 2 - \$500,000*

*(2) start up grants \$25,000x2 - \$50,000*

*Eckerd pays for search costs and picks up salaries and benefits in fall of 2012*

*(3) workshops on active pedagogics -\$10,000*

Our needs are to hire two interdisciplinary biologists, one who will do research in science education and one who has research in applied mathematics or modeling as it relates to the life sciences.

The biologist with a research interest in science education will teach a six course load during their first four years. Their charge includes instituting a year long teaching seminar for our juniors and seniors who are motivated potential secondary school science teachers (2 courses), co-lead workshops and discussions on active learning pedagogies for their science colleagues (a 1 course release from the standard 7 courses), teach two natural science area courses which infuse direct application of the scientific method to non-majors (2 courses) and teaching two courses within the biology discipline for majors and other science students. The motivation for this science education position is twofold: (1) Approximately 15% of our science graduates choose careers in teaching in primary and secondary education without any formal encouragement from the college (They usually follow an alternative certification route especially popular in the south-eastern United States where science teachers are in extreme demand.) (2) We have an active group that does research in science education (two physicists and a geologist) and four additional scientists who have attended national workshops, by invitation, to promote active learning pedagogies. This new faculty member would lead, with the help of our associate dean of faculty development (Katherine Watson

who has a doctorate in education), a new seminar which is designed for Eckerd College students who think they would like to choose as a career path teaching science in secondary schools. The cornerstone of this seminar would be a practicum with either Academy Prep or Canterbury secondary schools located in Saint Petersburg. By adding this new hire we will also strengthen our practitioners and researchers in contemporary science pedagogies. We understand that this type of research is a fledgling field in the life sciences so our search may also include those who do not have an active track record in the field but have shown a propensity for teaching with the newest pedagogies and are thus well positioned to begin contributing to science education research.

Our second hire, the mathematical biologist, will formally be part of the mathematics and biology disciplines. By having a stake in both disciplines they will increase dialog (for example examine in what ways the calculus course can be infused with more biological examples) and serve as a catalyst for future development of more interdisciplinary courses between the two disciplines. This has been done with physics and mathematics in the recent past and it has helped strengthen both disciplines. This scientist, depending on their specialty, will strengthen our bio-informatics, computer modeling, or molecular biology courses. They will be expected to teach pre-calculus and calculus with their mathematics colleagues and in their second year lead the development of a new required mathematics course for biologists.

With these two hires we will have increased the number of faculty members who use active learning pedagogies regularly to about ten (a fourth of our science faculty). This quorum will lead a series of active learning workshops and discussions specifically for science faculty. Those who will develop and plan the workshops are the new science education hire (with a course release), our esteemed science professors who have won distinguished teaching awards, and our associate dean for faculty development who has experience leading workshops for the general faculty.

### **3. Curriculum, Equipment, and Laboratory Development (3500 characters)**

*(1) Teaching Skills Assessment Program - \$10,000*

*(2) Development of modeling tools and database \$36,000*

*(3) Purchase of commercial modeling software - \$10,000*

*(4) Molecular biology materials - Denise*

On the Eckerd campus, under the division of Special Programs, we have an Alternative Certification for Teachers Program designed for those that have already graduated. The teaching practicum seminar that we propose, while not connected to that program, will be able to use resources created and assembled by that program including literature, discussion ideas, and student assessment. These resources include an internally created *Teaching Skills Assessment Program* (TSAP) which will be administered to our seminar students to help the students gauge their motivation for teaching. The administrators of the Alternative Certification for Teachers

Program (Eileen Wetmiller) will also will be available to the teaching seminar class for special sessions on certification pathways and resume building. As a preliminary test of this program we will begin this practicum in the spring of 2008 with a test group in which a current Eckerd faculty member has volunteered to lead this initial seminar.

Our faculty contains three esteemed science model designers. Cox, a full professor in physics, has been a co-principle investigator and a consultant on NSF grants which have developed Java models for physics. Junkin, a full professor of physics and the Director of Instructional Technology, has a twenty year history as a principle investigator on grants regarding science education. Wetzel, an associate professor specializing in marine geology, has been a contributor to a National Science Foundation Project, "Spreadsheets Across the Curriculum", and uses Excel spreadsheets to model science. These individuals will lend their expertise in developing 6-8 biological models. The subject matter of these models will germinate from consultation with biologists and other life scientists and then once finished these modules will be tested at Eckerd College and then released to the general public via access on the Internet. During the first year of the grant we will purchase commercially available modeling software so our biological colleagues can become familiar with the integration of modeling in the classroom and can also be more effective consultants when they help design the modules mentioned above. This aspect has the ancillary effect of increasing interdisciplinary dialog between a wide variety of scientists on the increased role of computational models in the classroom.

There is also a genuine need to increase our biology curriculum for the scientist as well as the non-scientist. With these new hires we will be adding five courses of teaching resources to the biology discipline per year and will thus be able to teach more molecular biology, immunology, and neuroscience courses on a regular basis... (Denise)

#### **4. Pre-college and Other Outreach (3500 characters)**

*(1) Gifts to Academy Prep and Canterbury - \$25,000x2 = \$50,000*

*(2) Research opportunities for secondary school teachers: second year \$16,000, third year \$20,000, fourth year \$20,000 = \$56,000*

*(3) Workshop equipment and stipend for secondary teachers \$8,000 x 2 = \$16,000*

We have invited the secondary institutions of Academy Prep and Canterbury School to be our partners in this active exchange program. We will send our Eckerd College student teachers to them where they will be given orientation and assigned to a teaching mentor who will be on the faculty of one of the institutions. These institutions would also be involved in outreach programs with the college. Although we have had informal relationships with both institutions previously, this grant would strengthen the alliance and is only the beginning of a potentially rewarding exchange

between secondary education and Eckerd College in Saint Petersburg. We would ask for a one time gift be given to both institutions to allow a purchase of scientific equipment to add to their respective classrooms. One of these institutions, Academy Prep (grades 5-8), serves the local area of southern St. Petersburg where a majority of students do not graduate from high school. Academy Prep has, since 1997, has been "breaking the cycle, one child at a time". They rely on government and private donations to execute this mission which is to provide a tremendous service to the community by motivating 95% of their graduates to finish high school. Two Eckerd graduates are on the faculty at Academy Prep. The second institution, Canterbury School (grades K-12), has an emphasis in marine science, which is also a strength of Eckerd College's being its largest science major. It complements the agreement well because it has a large college-bound population which is interested in science and therefore many more classrooms for our students to assist in. Three Eckerd graduates are on the faculty of Canterbury school.

Another outreach objective is to offer summer research opportunities to teams comprised of incoming freshmen and upper division students who will conduct research with middle and high school science teachers from Academy Prep and Canterbury under the supervision of Eckerd College faculty. This new program, the Outreach Research Program (ORP), will be similar to and emulate NSSRP's successes and also add the components of inter-generational team problem solving, mentoring, and collaboration. The teachers will work forty hour weeks and be given a stipend of \$4000 for the summer. By bringing teachers into the lab space and having them participate in basic scientific research, they will gain new skills as well as the confidence that they can use to enhance their classroom instruction. By developing these multi-level research teams for summer research, Eckerd's undergraduates will also learn about opportunities for teaching science in high school. ORP teams will not replace the current NSSRP research program for Eckerd's students; rather, it will be an additional avenue for collaborative student and faculty development and research.

Also during the summer of 2010 and the summer of 2011 a combined workshop will be held between the three institutions on the Eckerd campus. Each workshop will have a different curriculum theme developed and lead by Eckerd faculty. These workshops will provide the teachers to be led through a creative hands-on modern biology project. We will then provide enough equipment for the teachers that they can then take what they have learned back to their classroom. Potential topics include molecular biology and immunology.

## **5. Program Administration, Assessment, and Dissemination (3500 characters)**

*Consulting fees to school liaison - \$5000*

The central location to keep the public informed of our procedures, status, and assessment of the grant will be a website located off our main server "[www.eckerd.edu/HHMI](http://www.eckerd.edu/HHMI)" and it will be

maintained by the program director Reggie Hudson. The page will contain all documents pertaining to this grant.

For the summer research program both the traditional NSSRP and the outreach ORP will be administered by the same process. As presently done faculty will submit a formal proposal to the Chair of Natural Sciences that describes in detail the nature of the research, student involvement, and plans for seeking extramural funding;

Applications are reviewed by the faculty researcher and the Chair of Natural Sciences. Previous award history will be reviewed in an effort to maintain equity among the disciplines within the Natural Science areas and awards are announced in late *March*.

Another important part of the proposal which needs administrative oversight is the approval of modeling projects. The modules need to be substantial, easy to use, rigorously tested and applicable to the biology community at large. A committee will be formed of the three Eckerd scientists with modeling experience, three Eckerd biologists and two external reviewers (a computer scientist and a biologist from Wofford College) who have recently written a book on computational modeling which has used many biological examples. Applications for development of modules will come mainly from within the committee but may also be solicited from outside. This committee will determine which modules are approved and at what level they are funded.

Another assessment goal of the summer research program at Eckerd College is to contribute to the SURE program. Data from SURE provide insight into the role of undergraduate students who always anticipated entering graduate and medical programs, implying that the traditional structure of undergraduate research solidifies the career plans of highly motivated, self-selected students, while influencing only a minimal number of previously uninterested students to consider science research as a career. We will track student responses/attitudes about research experiences in order to ascertain if early introduction to research will indeed foster greater interest in basic science careers.

We will hire an external liaison who has had years of experience working in the Tampa Bay school systems to annually review our secondary education science program and make suggestions for improvement. The report will be put together by the Associate Dean of faculty and the new science education hire who oversees the practicum and will be due in mid summer of 2009 and 2011. We will put their report and the response on our website. We will also vigorously keep track of our the graduates of this program. We will also measure the effectiveness of the program via a survey two years after they have left Eckerd College.

A Workshop with Academy prep and Canterbury will take place during the summer of 2010 and 2011 workshops where assessment will take place via surveys and candid break out sessions. Perhaps more importantly a discussion of long term goals for the three institutions relationship will be discussed and reported.

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**Previous Funding Outcomes (1400 words) (Hudson)**

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***Proposal Narrative (7000 words)***

***Introduction (about 500 words) (Hudson and Grove)***

***(a) needs***

***(b) overview of institution and its educational mission (distinctive elements)***

***(i) programs and faculty***

***(ii) recent aims at strengthening undergraduate education***

**Components**

***(1) Student Research and Broadening Access to Science (Dayton, Grove ) (about 1000 words)***

*(1) increase in Eckerd student stipends - \$25,000 x 4 years = \$100,000*

*(2) increase in supply budget -\$10,000 x 4 years = \$40,000*

*(3) increase in faculty stipend -\$10,000 x 4 years = \$40,000*

*These costs will be picked up by Eckerd College after the grant funding is over (\$45,000 per year)*

Experiential learning has been an important element of the Eckerd College experience from the College's inception as Florida Presbyterian College in 1958; this has been true for the natural sciences as well as social science and humanities. Over the College's short history, such learning experiences have increased to include internships, local and international service-learning experiences, and student-faculty research. Research experiences for undergraduates, based on analyzed survey data collected by the Survey of Undergraduate Research Experiences (SURE) Program sponsored by HHMI (Lapotte, 2004) and by SRI International for the National Science Foundation (Russell, 2006) indicate that research experiences for undergraduates keeps previously interested students moving positively toward graduate level study in science or medicine.

The Natural Sciences Summer Research Program (NSSRP) was established in 1991 with HHMI



grant funds. Since then the student-faculty research experiences in science have become such productive learning opportunities for students that both the interest in and funding for the program have increased. In the last six years, Eckerd College has added \$15,000 to the Program's budget, bringing the total to about \$60,000. (This funding does not include research opportunities that are fully supported by external grant funding secured by individual faculty members, e.g., from the US Geological Survey (USGS), National Science Foundation (NSF), Florida Fish and Wildlife Foundation, etc.) .

Since 2000 we have averaged 23 students per summer (ranging from 19 – 37), and sponsored a total of 187 undergraduates who conducted research with faculty members. These students are fully supported by NSSRP, i.e., they receive \$2,500 stipends + free housing in summer. Student research projects are of high quality and represent diverse interests; they lead to Senior Thesis research, presentations at professional meetings with their faculty supervisor, publications in peer-reviewed journals, and presentations at Eckerd's regularly scheduled symposia in several science disciplines.

The NSSRP, which was originally funded by our 1991 HHMI grant, had two components: required courses, namely *Introduction to Research*, *Research I*, and *Research II*; and earmarked funds to support only five students to conduct summer research with faculty. The original level of funding quickly became inadequate to serve the abundance of interested and qualified applicants during the four-year HHMI grant period when enrollment in the Marine Science major burgeoned in the early to mid 1990s. (The Marine Science Program was created in the late 1980s.) Thus, rather than support both formal coursework and laboratory experiences for just a handful of students, we decided to focus funding on the laboratory/ research aspect of the NSSRP.

We are satisfied with the overall quality of the NSSRP experience for Eckerd's students, but we want to increase the participant stipend in an effort to remain competitive with other programs that are available to motivated, qualified students. More than 90% of Eckerd's students receive some form of financial aid; hence, their summer support is significant to them. Therefore, beginning in year one and continuing throughout the HHMI grant period, we propose to increase the NSSRP stipend from \$2,500 to \$3,500, which is based on the \$4,000 stipend offered by the NSF's Research Experiences for Undergraduates. Eckerd College commits to maintaining the increased summer research funding level beginning with the summer of 2012.

In addition to increasing support for NSSRP participants, we propose to establish an Eckerd College Undergraduate Research Symposium. Through this, we will be able to celebrate the accomplishments of the student researchers within the Eckerd College community. The Symposium will provide opportunities for students engaged in research in all areas of science, the social sciences, and the humanities to present their work and to discuss the social and/or cultural implications of the science research topics. Student research would be presented in poster and

oral formats; then a keynote speaker would present current thinking in the featured area, leading a discussion of the topic and/or its broader implications in order to engage the non science disciplines. This forum will be held in conjunction with Eckerd College's Sigma Xi chapter, the National Honorary Society focused on scientific research, which brings scientific and non-scientific academic and non academic audiences to the campus. This mixed congregation of those interested in science provides our students – future scientists – the opportunity to prepare for their role as “civic scientists,” a role that is vital to the community’s scientific literacy.

**(2) New, Current, and Future Faculty Development (Flaherty, Weppner) (about 1500 words)**

*(1) 2 faculty hires (salary and fringe) : \$250,000 x 2 - \$500,000*

*(2) startup grants \$25,000x2 - \$50,000*

*Eckerd pays for search costs and picks up salaries and benefits in fall of 2012*

*(3) workshops on active pedagogics -\$10,000*

We will hire a PhD in the life sciences who has a history of, or a strong motivation to, carry out research in science education for a tenure track position. This person will be a member of the biology discipline and will have teaching duties within that discipline (two courses per year). This hire will augment a vibrant interdisciplinary group of scientists at Eckerd who actively research science education. In this group are a tenured physicist (Cox) and a tenured geologist (Wetzel). We also hired in 2005 a physicist who is a tenured professor and the Director of Instructional Technology. He is also active in science education research (Junkin). Cox is a past American Association of Physics Teachers Florida president and has been a co-principle investigator on a National Science Foundation grant and consultant on another. In these grants she has collaborated with faculty from Davidson College in developing curriculum material using "Physlets" which included co-authorship of one book and a contributing author for two others. Physlets are computer physics modeling simulations which facilitate a student's learning of key physical concepts through an interactive process using the computer. She has also helped develop applications for a software package "Tracker" which allows students to quantitatively analyze motion that has been captured on video and then can be used for modeling experimentation. Recently she has been consulted to develop modules using "Easy Java Simulations" package, a free program, similar in its aims to Stella. It provides a easy to use graphical interface which allows students to produce numerical solutions to differential equations. She has used modeling in her upper level physics courses and is planning to add computational modeling aspects to

roughly half of the introductory physics laboratories during the fall of 2007. Wetzel has been at the forefront of developing scientific modeling projects using Microsoft Excel, contributing teaching materials and serving as a workshop consultant for the National Science Foundation project "Spreadsheets Across the Curriculum". She also will be introducing more models into her classroom this year. Both Cox and Wetzel have been recognized by their Eckerd colleagues as leaders in innovative teaching by winning the annual prestigious Staub distinguished teacher award. Junkin came to us after a long career at Erskine College as a physics professor and an administrator where he was a PI on numerous science education grants. He has won the South Carolina professor of the year award administered by the Carnegie Foundation for the Advancement of Teaching in 1989 and the South Carolina Governors Professor of the year award in 1995. He currently develops active learning software that has been used on numerous campuses. We also have an administration which is supportive of increasing active learning pedagogies on campus. In June of 2007 two faculty members (in physics and marine science) applied and were invited to a National Science Foundation workshop to learn a software tool that promotes an interactive classroom. Also during the summer of 2007 Eckerd College sent three faculty members (in chemistry, marine science, and biology) to a Project Kaleidoscope workshop on innovative teaching methods.

To augment this group we propose this hire in biology education strengthening Eckerd College's commitment to having its faculty exposed to the forefront of education research and application. This hire will teach two science courses for non-scientists, two courses in biology, and a year long seminar developed for prospective science educators in secondary education each academic year. This faculty will teach the equivalent of 6 courses per year (at Eckerd College the standard is 7 courses). The new hire will also help invigorate our faculty development in active learning, hence the need for a course release. To keep faculty knowledgeable about student active pedagogies, HHMI funds will be used to bring the science faculty from Eckerd together to learn about these newer pedagogies and discuss new interdisciplinary curriculum ideas. The new hire, the associate dean of faculty development Watson, Cox, Wetzel, and Junkin will be asked to develop and lead these workshops. Since the Eckerd College natural science faculty is small (approximately 35 members), this workshop method is an effective way to reach a majority of the science faculty. In the past general "Teaching and Learning Sessions", developed by the Dean of Faculty and the associate Dean of Faculty Development have had a positive influence on faculty knowledge and ability to incorporate better means of supporting student writing abilities, student study habits, clicker input devices in the classroom, classroom technology and professor-student communication. These future workshops would be similar but would be focused on the special demands on teaching in the sciences. At the college the scientists have a long history of working with colleagues outside of their discipline. The two largest majors in the sciences are interdisciplinary: marine science and environmental studies. The scientists also meet once a month as a collegium and presently are involved in a science curriculum review study which is designed specifically beyond disciplinary needs towards the larger need of educating students (major and non major) toward general science literacy. Affecting the broader issue of teaching science to non-scientists, we do not require a laboratory in the non-science courses. The sciences and the other faculty have recognized this deficit in two

recent curriculum reviews but have found it difficult to find adequate faculty numbers to remedy the problem. At the present time 60% of these non-science courses are taught by non tenure track faculty. The proposed hire will teach two of these courses (about 25% of the total offered) with a newly augmented laboratory component. The new hire will also help develop curriculum for our science educator program (see the curriculum section below). The time table for this hire will be search in 2008-2009, hired for the fall of 2009. The salary and benefits of this hire will be picked up by this grant until Eckerd College assumes responsibility in the fall of 2012.

A mathematical biologist or modeling biologist will be hired and will serve in both the biology and mathematics disciplines. This new hire will increase dialog, play a role in future biological and mathematical hires and thus serve as a catalyst for future development of more interdisciplinary courses between the two disciplines. Our life scientist students presently take the same calculus course as the mathematicians, physicists, and chemists. We are proud of the rigor that this offers the life science students, however as expected, this leads to an emphasis on theory in the mathematics courses with few life science examples ever attempted. As the new hire becomes acquainted with the campus we expect them to help guide both disciplines closer together by a "cross pollination" of the two disciplines and formally with the development of an additional required mathematics course specifically for the life sciences. Biology 2010 has a few recommendations on what type of course this should be and we will use this as a guide. We plan to have this new course offered in the classroom by the fall of 2010. They will also help establish the biology modeling minor (see the curriculum section). The time table for this hire will be search in 2008-2009, hired for the fall of 2009. The salary and benefits will be picked up by this grant until Eckerd College assumes responsibility in the fall of 2012.

Both hires will bring an additional 5 courses to the biology discipline per year. We do not want to specify their biological expertise any further so that we will have adequate candidate pools for both hires but ideally we would hope that one of the two hires would augment our growing molecular biology program.

### ***(3) Curriculum, Equipment, and Laboratory Development (Dayton, Flaherty, Weppner) (about 2000 words)***

- (1) Teaching Skills Assessment Program - \$10,000*
- (2) Development of modeling tools and database \$36,000*
- (3) Purchase of commercial modeling software - \$10,000*
- (4) Molecular biology materials - Denise*

Science educators in secondary education are in great demand especially in Florida and the growing southeastern United States. In the past decade over 10% of our science graduates have had a teaching job in a primary or secondary classroom. The usual method our students have obtained these jobs is through alternative certification where the student takes the necessary classes while on the job to earn certification.

We feel that by exposing prospective science teachers to a practicum seminar we will celebrate teaching as a career option, acknowledging its importance for our future, and also giving our students valuable classroom experience so they can determine if they are suited for a career in science education through either the alternative pathway or earning a Masters in education after graduation. This year long seminar will be labeled a science education concentration. A course was offered at Eckerd College about teaching secondary education in 2004. Fifteen people were in that course; we expect roughly the same numbers the first time we offer the course.

The new faculty hire in biology science education will lead this seminar class with significant consultation from the Associate Dean of Faculty Development, who has an education doctorate, and with the resources of the Alternative Certification for Teachers Program located on the Eckerd campus. This group has developed assessment tests (TSAP), literature resources, and contacts with the school systems in most of the state of Florida. This year long seminar will have as a major component a student practicum at a local secondary school. The student will assist a science teacher at this school in preparing and teaching in the classroom. They will begin their practicum with an orientation at the local school, their role will be determined by the science teacher and may include preparing the classroom, assisting the teacher and students, helping to design lesson plans, and leading activities under the supervision of the teacher. At Eckerd College they will meet weekly in seminar and reflect on their experiences in the classroom, read current literature and be regularly tested. They will also be assessed formally on their teaching potential by taking the internally developed Teaching Skills Assessment Program.

We have two schools which will be involved in this program with us. Canterbury School is a private school serving students from kindergarten through 12th grade located in St. Petersburg (about 20 minutes from Eckerd College) which has an emphasis in Marine Science. We presently have three Eckerd graduates teaching there. Academy Prep is a private middle school (5th through 8th grade) designed specifically for children of low income families. These schools have had many informal relationships with Eckerd College in the past and are excited about seeing our relationship develop further. Both schools have agreed to begin this internship program in the spring of 2008 under the supervision of Anne Cox and another faculty member in the spring of 2009 so that when the faculty is hired in the fall of 2009 the program will have already been running in a pilot state twice. The pilot stage we believe to be necessary because this teaching seminar experience is new to both us and the two recipient institutions. We will also have these schools involved in the outreach component discussed later.

We also plan to grow our computational modeling exposure in biology. To first establish the use of discipline-specific quantitative and computational exercises to allow students to both build their skills as well as foster knowledge of the application of these methods we will purchase some commercial computational models. A stepwise introduction to computational aspects of biology will be introduced in our lower-level courses, and progress in use, application and understanding right on through upper-level courses. To begin, the 100-level courses will contain lecture/laboratory units in which modeling applications are used to reinforce the organismic concepts. As most students will be taking calculus concomitantly this will be the

first avenue to request that students apply a calculus concept to a biological problem. As students progress through their sophomore year, the modeling units will include protein analysis, genome modeling and data mining. Most biology students take a statistics course during their sophomore year, therefore, a concerted effort will be made to show students how to apply their statistical knowledge to a biological problem. Finally, in their third and fourth years, most biology students take Physiology and Ecology. Both of these subject areas are ripe for dynamic computer modeling of processes, which will be added to the respective curricula. These upper-level required courses will feature the most use of quantitative data analysis, and computer modeling for projected outcomes.

The three esteemed educators mentioned in the previous section all do research in developing computational scientific modules and storage databases for these scientific models. With such a concentration of expertise available on one campus it seems natural that they help develop modeling packages for the biological community. An aspect of their work which is attractive is that their models can be run on popular and readily available software which exists on all higher education campuses. Professor Cox does her modelling work using Java which is freely available and usually already installed by the manufacturer on educational machines. Wetzel uses Microsoft Excel which is also readily available (or its Open Office counterpart). Junkin, as a consultant to an NSF grant has been developing a highly flexible and searchable international database to store and disseminate physics modeling curricular materials as part of the National Science Digital Library and are freely accessible to everyone through the Internet. At the moment his data base contains hundreds of physics modules and, under the proposal, will be extended to include modules from biology and other disciplines. The proposal asks for monies to pay for the development and dissemination of 6-8 biological models. These models will be created by these experts under the consultation of internal and external biologists. They will be rigorously tested on the Eckerd campus in the classroom and then will be made accessible via the Internet. Each developer will be paid \$2500-\$5000 per package developed.

To encourage a deeper understanding of the real math and computation behind biologically important computer programs, we propose the development of a minor in Biological computational science. This minor will consist of the following courses: Bio-informatics, Calculus I, Physics I, Genetics, Introduction to Computer Science, and a new course in Computational Modeling. Two faculty members currently on staff at Eckerd already have experience in teaching modeling at the undergraduate level and one of the new hires detailed in this proposal may also have the expertise needed. This new venture has the added benefit of not only appealing to biology students, but also mathematics, computer science, marine science or physics majors. We also are determined to make this attractive to our biology students by actively pursuing internship possibilities for those who have completed the minor. Eckerd College's Director of the Center of Applied Liberal Arts, has been directed to search for such opportunities and has found half a dozen thus far. We have had many of our analytical science students get computational work at places like USGS, Moffit Cancer research (*ask K. Debure*) we would like to open up similar venues for our life science students.

Currently, the majority of Eckerd biology students pursue fields of study, and later, careers, that are ecosystem/organismic focused. The higher level of student interest in ecosystem/organismic questions has been due to Eckerd's tradition of excellent field work in ecology, environmental issues and marine science. Over the past few years, however, there has been a rigorous effort to parallel that success with a powerful set of courses in the cellular and molecular aspects of biology. In addition to developing new courses and curricula, this effort has been fueled by new faculty hires with cell/molecular research projects and new equipment such as a micro-plate reader, a micro-injection and microscope setup, PCR thermocyclers and a *Licor* DNA sequencer. The recent staff, curriculum and equipment additions have yielded an abundance of students who are pursuing, or wishing to pursue, more molecular approaches to their research projects. Students are also seeing that what used to be considered traditional ecological or species research, such as tracking populations of certain animals, now relies on techniques from genetics and molecular biology. We are also seeing a steady increase in students going on to graduate programs that are based in cellular and molecular research. On this foundation, we seek to strengthen our molecular biology, genetic and neuroscience curriculum, the two new interdisciplinary hires will allow the biology department more flexibility in allowing these courses in constant rotation.

We know that the upper-level cell and molecular based courses will better prepare our students for the real challenges of graduate work or bio-tech research, as well as increase their preparation and competitiveness for medical school. With these two additional hires it will allow us to be able to continually offer more molecular, genetic, and neuroscience courses to our students. To complement our molecular biology offerings as part of this proposal we would like to purchase... (*Denise*)

#### ***(4) Pre-college and Other Outreach (Weppner, Wetzel, Dayton) (about 1200 words)***

*(1) Gifts to Academy Prep and Canterbury - \$25,000x2 = \$50,000*

*(2) Research opportunities for secondary school teachers: second year \$16,000, third year \$20,000, fourth year \$20,000 = \$56,000*

*(3) Workshop equipment and stipend for secondary teachers \$8,000 x 2 = \$16,000*

This proposal details an increased relationship with two local secondary schools, Academy Prep and Canterbury. They are inviting our students to their institutions to become familiar with the teaching profession, it thus seems natural to extend an invitation to their faculty and students to Eckerd College to participate in summer programs. These schools were chosen because they fulfill a certain niche which Eckerd College finds attractive. Academy Prep is only five minutes from the college. Although the college rests on the Gulf of Mexico and is surrounded by affluence, if you travel five miles inland one finds themselves in the historically racially segregated area of St. Petersburg. Like many southern cities St. Petersburg has struggled with developing programs to progressively improve the education and livelihood of the residents of this community. Eckerd College has actively made significant efforts to improve the businesses in the area.

Academy Prep, established in 1997 as a non profit educational center, has slowly and systematically given hope to many of the area's youth who historically have not had a high rate of high school graduates. Since its establishment Eckerd faculty have informally, on a small scale, helped tutor, teach, and lend equipment to Academy Prep. We have three graduates of our college who teach there through an alternative certification program. This grant proposal has given us motivation to move this relationship to a stronger, more formal, and wonderfully symbiotic relationship. Canterbury School is a private secondary school institution located in northern Saint Petersburg. It is a vibrant school that has a high rate of success at producing successful college bound graduates. The school has broken ground on a new marine studies center and has developed stronger ties with Eckerd College. Our Vice President sits on the board of trustees, their boat is anchored on our campus and we have three Eckerd graduates teaching there. Canterbury School administrators are also very excited about having the possibility of having their faculty and high school students do some community service for Academy Prep to make this symbiosis complete.

To give these two institutions a recognition of thanks for giving our students opportunities in their classrooms we ask for a one time gift of \$25,000 for each school as a donation to buy needed science equipment to update their classrooms. The schools plan will be...

We also planning on including teachers from these two institutions for summer research opportunities. Teams comprised of incoming freshmen and upper division students who will conduct research with middle and high school science teachers under the supervision of Eckerd College faculty. This new program, the Outreach Research Program (ORP), will emulate NSSRP's successes and also add the components of inter-generational team problem solving, mentoring, and collaboration. This new program will have several benefits for its varied participants:

- Funding short falls combined with proscribed instructional objectives related to state-mandated comprehensive assessments in science, too often lead to rote, uninspired science instruction in schools. By bringing teachers into the lab space and having them participate in basic scientific research, they will gain new skills as well as the confidence that they can use to enhance their classroom instruction. Interviews with teachers who participated in similar programs reveal that even when participants had reservations about the value of participating in basic science research, they found that the experience provided invaluable tools that they accessed when they returned to their classrooms;
- By developing multi-level research teams for summer research, Eckerd's undergraduates will learn about opportunities for teaching science in high school and the team's science teachers will be encouraged to request that the Eckerd students volunteer in their classroom through Eckerd's course-related service-learning and/or the required institutional service-learning experience; and
- ORP teams will be established with the goal of intense interaction among all participants. "Real" faculty research projects, using scientific processes and equipment and resulting in the analysis of "real data" will serve as the backbone of these discussions. We anticipate that both the teachers and our Eckerd students will gain a broader understanding of the importance of team activity, i.e., the



contributions that different points of view and experiences offer when conducting scientific research. ORP teams will not replace the current NSSRP research program for Eckerd's students; rather, it will be an additional avenue for collaborative student and faculty development and research. The application procedure will be similar to that of NSSRP, but with marketing of the program in the public and private high schools in the late winter via science supervisors and/or professional development specialists in order to attract teachers. Projects will consist of eight-week intensive summer research, i.e., 30-40 hour/week commitment by participants in order to provide sufficient time for "meaningful" research but also accommodate the teacher's summer schedule. The HHMI Project Director will award up to five ORP projects per summer; projects that propose continuation throughout the academic year will be granted priority, but year-long participation is not mandated. All ORP participants must submit at least one presentation (oral or poster) to the Eckerd College Research Symposium, as well as one abstract to an outside symposium. This program will begin in the second summer of the grant funding.

*\* Mention article found by Iris on the beneficial effects of having secondary teachers mingling with higher education \**

During the summers of 2010 and 2011 on the Eckerd campus we will have two Saturday workshops for the science faculties and administrators of Eckerd College, Academy Prep, and Canterbury. These workshops will include the traditional science workshop for the secondary institutions. A theme will be chosen which will give them plenty of usable resources to take back to the classroom. A good number of the Eckerd science faculty have worked with high school teachers in workshops through NSF grants, the American Association of Physics Teachers, the American Association of Mathematics teachers, ...It will also have discussions amongst administrators and faculty on how to creatively grow our ties with each other. Each workshop will have a budget of \$8,000. The secondary school teachers and Eckerd faculty will be given a small stipend (\$200) to attend the workshop (we expect about twenty faculty participants), we will use the rest of the monies to buy equipment that the secondary school teachers will be trained on and then will also take back to their classrooms.

### ***(5) Program Administration, Assessment, and Dissemination (about 1200 words)***

*Consulting fees to school liaison -\$4000*

The central location to keep the public informed of our procedures, status, and assessment of the grant will be a website located off our main server "[www.eckerd.edu/HHMI](http://www.eckerd.edu/HHMI)" and it will be maintained by the program director Reggie Hudson. The page will contain all documents pertaining to this grant. This page will contain links to the seminar course, links to the modelling repository, and our summer research projects that were funded and anything else HHMI related

The application procedures for *Natural Sciences Summer Research Program* (NSSRP) and the *Outreach Research Program* (ORP) are as follows:

- Faculty submit a formal proposal to the Chair of Natural Sciences that describes in detail the nature of the research, student involvement, and plans for seeking extramural funding;
- Applications from are reviewed by the faculty researcher and the Chair of Natural Sciences. If questions related to final selections arise, consultation with other faculty members is sought. Final selection is made by the Natural Science Chair
- Previous award history is reviewed in an effort to maintain equity among the disciplines within the Natural Science areas; and
- Awards are announced in late March
- In the second year of funding there will be four ORP teams composed, in the third and fourth year there will be five.

The committee to choose modeling ideas will be composed of seven Eckerd faculty: Cox (physics), Junkin (physics, Instructional Resource Director), Wetzel (marine geology), Dayton (molecular biologist), Flaherty (biochemist), Meylan (ecological biologist) and Forsys (environmental science, ecology) and two external reviewers from Wofford (a computer scientist and a biologist). Each applicant who desires to create a modeling package (eg. not just a computational model, but an appropriate lab or classroom exercise which includes the model) will submit a 2-4 page application that includes statements of objectives, procedure, applicability, demand, and time-table for production. The project must be done on a platform which allows others to use the model without having to purchase auxiliary software. Each accepted project will be funded from \$2500-\$5000 depending on the length of the perceived development. The first projects will be developed starting in the late spring of 2009. We will begin with a workshop lead by our on campus modeling experts, we will discuss different types of ways that the computer modeling has worked in the classroom. Ideas for models will then be collected and applications produced. Once an application is accepted the team is expected to work over the summer months writing the model and the surrounding curriculum material. The models will be tested by student researchers. The first 3-4 models will be ready to use by the fall of 2009. We will repeat the cycle in 2010-2011. In 2012 we will disseminate our models through science modeling publications, conferences, and making the models and curricular materials available on the Internet.

An assessment component of the summer research program at Eckerd College is to contribute to the Survey of Undergraduate Research Experiences (SURE). Data fro SURE provide insight into the affect that undergraduate research experiences had on the persistence in undergraduate science and desire for graduate study in science of highly motivated, self-selected students. Our goal for placing incoming freshmen with a declared interest in science into the research lab in the summer prior to their matriculation will be to provide them with a team experience that offers mentoring from upper level undergraduates, secondary educators, and faculty members. As indicated in the SURE study and the SRI Evaluation of NSF programs, the relationship between students and their research groups is highly correlated with a decision to remain in

research. Therefore, we anticipate a very positive response to this research-team structure. Students will complete the SURE II/III surveys as a mandatory exit interview; teachers will complete related but different assessment instruments at the end of the experience. Students who are funded for NSSRP will be required to share their attitudes about their research learning experience not only at the end of the summer, but throughout their science major experience in order to ascertain the relationship between early introduction to research and interest in basic science careers.

We will also hire an external liaison who has had years of experience working in the Tampa Bay area school systems to annually review our program and make suggestions for improvement. The report will be put together by the Associate Dean of faculty and the new science education hire who oversees the practicum and will be due in mid summer of 2009 and 2011. We will put the report and response on our website. We will also vigorously keep track of our graduates and follow their career paths. We will access their progress via a survey two years after they have left Eckerd College. Example syllabus and links to literature from the seminar class will also be made available on the website. The hope is that if this is a successful program we will then add other secondary schools to our list of participating institutions.

A Workshop with Academy prep and Canterbury will take place during the summer of 2010 and 2011. These workshops will primarily be used to disseminate new teaching ideas but assessment will also take place via surveys and candid break-out sessions. Perhaps more importantly the long term goals of the three institutions relationship will be discussed. The assessment will help us determine the long range plans of our potential teacher practicum program as well as any other innovative ideas that spring from these workshops.

***Budget Justification (5000 characters per budget component)***