

Project Summary: *Making the land-sea connection in inner-city Richmond classrooms: Bringing the Chesapeake to school and bringing students to the Bay.*

The goal for this project is to create a service-learning course for University of Richmond (UR) undergraduates (*Marine Biology of the Chesapeake Bay*) that will actively involve college students in elementary science classes. The structure of the course is based upon well-tested pedagogical strategies developed by leading scholars of service-learning courses. In *Marine Biology*, UR students will learn about the Chesapeake Bay, its watershed, and environmental issues facing the Bay through direct data collection, observation, and hands-on activities. The PI and students will join 5th grade classrooms to help teach elementary students about the Bay. A major goal of the course is to provide meaningful outdoor experiences for all students. The principal and teachers from the partner school (Albert V. Norrell Elementary) have indicated strong support for this project and the PI has frequently met with teachers to obtain guidance on the optimal way to achieve success with the proposed activities. During the semester, UR students will learn how to conduct water quality tests, monitor fish migration, conduct plankton tows and seine netting, quantify populations of plankton, conduct plant surveys along the James, examine coliform bacteria levels, and analyze data from their own experiments in an appropriate manner. As a culmination of their experience, students will then apply what they've learned by working with 5th grade classes in a peer-mentoring environment. Another goal is to create a long-term dataset of environmental quality of the Chesapeake that is compiled by UR undergraduates and 5th grade students over multiple years. The proposed course provides opportunities to build integrated and strong working partnerships between UR and the Richmond Public School system. *Marine Biology of the Chesapeake Bay* will strengthen the scientific literacy and fluency of UR undergraduates, motivate undergraduates to consider a career in teaching, and inspire elementary students to care about their education and their environment.

GRANT PROPOSAL: *Making the land-sea connection in inner-city Richmond classrooms:
Bringing the Chesapeake to school and bringing students to the Bay.*

Goals and Objectives

Our goal is to create a service-learning non-majors science course that will provide University of Richmond students opportunities to increase their scientific literacy and appreciation for the scientific method. Fluency in communicating scientific topics will be strengthened through teaching opportunities in a local elementary school.

There is an abundance of evidence supporting the idea that service-learning is an extremely valuable mechanism to engage non-science majors in scientific classes (Eyler et al. 2001; Billig and Furco 2002; Colby et al. 2003; Jacoby 2003). Indeed, the National Science Foundation funded an ambitious project to explore this specific topic (e.g., Bachofer and Martinelli 2005; Pierce et al. 2005). The Science Education for New Civic Engagements and Responsibilities (SENCER) has provided ample evidence that service-learning contributes to “improving general education for the student who has expressed little interest or inclination to study in the sciences and mathematics” (Siebert 2004). To reach these students, we will create a course (*Marine Biology of the Chesapeake Bay*) that engages student interest and teaches basic science using complex public issues associated with the Chesapeake Bay in Virginia. Furthermore, our undergraduates will convey their understanding of the science to 5th grade students in a local elementary school.

We will establish an integrated and strong working partnership between UR and Richmond Public Schools that tightly links classroom activities with academic standards of learning (SOLs) for the state of Virginia. This proposal is the initial step towards creating a long relationship between the sciences on UR’s campus and the science classrooms in the city of Richmond. We will work closely with The Corella & Bertram F. Bonner Center for Civic Engagement on UR’s campus to achieve this goal.

Background and Significance

Almost one-third of Virginia's population lives in the James River watershed. Richmond is largest municipality on the James, and the city identifies strongly with the river. However, many residents are not aware of the important connection between the James River, the Chesapeake watershed, and the Bay. This is especially true of many of the non-science major undergraduates at UR. According to the Virginia State Water Control Board, the James receives the highest nutrient inputs of any river in Virginia. Nitrogen and phosphorous inputs increase the risk of algal blooms and the creation of dead zones. The release of the toxin Kepone into the James in the 1970s was a significant environmental problem that remains a concern. Finally, overflow water during large storms generates pulses of untreated sewage into the James, which can lead to unhealthy levels of fecal coliform bacteria. UR students need to be made more aware of scientific consequences of these types of environmental problems.

To introduce a service-learning component to the course, we have partnered with administrators and teachers from the A.V. Norrell Elementary School. Recent statistics (2004-05) for this school indicate that >90% of the population is African-American. A. V. Norrell was built over a landfill in the 1960s. Several environmental problems ensued (e.g., methane leaks in the 1970s) forcing the relocation of students until problems could be remedied. The school is located in an economically depressed region of the city and qualifies as a Title I school. Three quarters of the students qualify for free lunches. In subsequent offerings of the course, we plan to expand the number of schools to include Whitcomb Court and Overby-Sheppard schools.

Project Plan

A non-majors *Marine Biology of the Chesapeake Bay* course will be created at UR. We will train students in the best science currently being done in marine systems. The emphasis of this course will be on the Chesapeake Bay and the environmental concerns we face in this vital

ecosystem. Students enrolled in *Marine Biology* will use their developing skills in marine science through a series of field-based laboratory experiences. The PI has taught non-majors marine science courses in the past and will use topics outlined in one of the leading texts (Nybakken and Bertness 2004) as a rubric for the syllabus. The course will be taught in spring 2007. During the first two semesters of the course, traditional lectures will cover topics such as an introduction to 1) basic oceanography (chemical and physical properties of water), 2) plankton communities, 3) larval ecology, 4) benthic and intertidal ecology, 5) deep-sea biology, and 5) estuaries/marshes.

The laboratory portion of the course will involve a series of field-based experiences at a variety of sites in the Chesapeake Bay to collect data on topics covered in class. The PI has established a number of sites within the Bay that are ideal for undergraduate students and has taken students in his Ecology and Tropical Marine Biology courses to all of the sites. For example, a beach at Gloucester Point, VA (near the Virginia Institute of Marine Science) is a perfect location for a large class to conduct seine netting and plankton netting.

As the semester progresses, UR students will develop appropriate modules for 5th grade classes focused on topics they learn in the class. An important aspect of this grant application is advice and guidance that will be available from three experienced K-12 educators during all phases of this project. Dr. Cathy Fisher is a past principal from the greater Richmond area and currently serves as Director of the Teacher Licensure Program at UR. Dr. Patricia Stohr-Hunt is Chair of the Education Department and Director of Teacher Education at UR. Both have agreed to support this project by working with students in the *Marine Biology* course (see supporting letters).

Ms. Sue McGinnis will also be involved in this project. Ms. McGinnis is an expert web designer and was a 4th and 5th grade teacher in Chesterfield County, Virginia. As a teacher, Ms. McGinnis created a set of curricular activities built around a virtual explorer known as “*Vern*.”

Ms. McGinnis has indicated that she could easily help students create wonderful Bay-specific activities using *Vern* as the medium.

A series of site visits to A. V. Norrell are planned during the lab period towards the end of the semester. These activities will give elementary school students hands-on experience with the scientific equipment they will use during the outdoor experience that will come later in the school year. We will bring in examples of some of the organisms living in the Bay (e.g., fish and crabs; sessile invertebrates; planktonic organisms). A series of stations run by *Marine Biology* students will introduce 5th graders to tools commonly used by marine scientists working in the Bay (e.g., SCUBA, plankton tow, seine net). We will also take 5th grade students to the Chesapeake Bay in May to conduct a wide variety of water quality analyses during a half-day outdoor experience. During the next week, the PI and students will go back to the classes to provide guidance on analysis and interpretation of the data.

The PI and 4 students from the *Marine Biology* class will work for 3 weeks on *Marine Biology* activities in the month of May. The 4 students for this portion of the activity will be selected from the class based on their stated interest in post-graduate environmental education. These students may come from our vibrant Environmental Studies major, or from a new UR program centered on Living/Learning Communities. These communities are comprised of students who share interests (e.g., in environmental issues), live together, and work on joint outreach projects.

Prior Activities Related to Proposal

The PI of the project (Dr. Malcolm Hill) is a marine ecologist who conducts research in the Chesapeake. He has published scholarly articles in environmental and ecological fields and has published inquiry-driven lab activities for undergraduates in the area of environmental pollution. He has taught marine science courses to non-majors in the past. Dr. Hill has extensive experience in curricular innovation and was lead author of a Pew Center for Academic Transformation grant

to redesign introductory courses at Fairfield University. He will develop and teach *Marine Biology*. He will also oversee and directly contribute to all scientific and outreach activities associated with this grant. Over the past year, Dr. Hill has performed educational outreach activities focused on the Chesapeake in 5th grade classrooms in the greater Richmond area. He is enthusiastic about expanding, strengthening, and broadening these activities.

Projected Timetable

The development of the course and preparation for the field activities will begin in the summer of 2006 and will continue through the fall semester. The course will be offered in spring 2007. Assessment of the activities in the course will take place in the late spring of 2007. We will disseminate results from the program through talks at national meetings and publications in leading educational journals.

Requested Budget

Personnel	Total
Student Leaders (4) in month of May @ \$300 per week X 3 weeks	\$3600
Travel	
Undergraduate trips to sites to develop skills and curricular content (@ \$0.39 per mile) X \approx 100 miles per trip X 20 trips.	\$780
Two field trips with entire Marine Biology Class to visit sites and use scientific equipment	\$351
Supplies	
Water Sampling and Monitoring Equipment	\$8579
Other	
Student Housing in May @ \$75 per week	\$900
TOTAL COSTS	\$14210

Personnel: Stipends for the *Marine Biology of the Chesapeake* student leaders included for the 3 week period (\$300 per week) for a total of \$3600. Future iterations of the course will require less work, and thus will not require the stipend requested in the first year.

Travel: Students enrolled in *Marine Biology* will take trips in their own vehicles to different sites with the Chesapeake Bay watershed for activities tied to the goals of the course. UR rate for travel

is \$0.39 per mile. The average roundtrip distance will average 100 miles. Three university vans for the course will be required during trips to field sites with the entire class (≈ 150 miles @ \$0.39 per mile X 3 vans).

Supplies: Monitoring equipment will be bundle together as a traveling environmental workshop.

Prices quoted below come from various biological supply companies (e.g., Ward's, Carolina

Biological) and represent lowest prices found. Necessary material includes: 20 Hip Waders @ \$75 each (\$1500); 30 Water Bottles @ \$5 each (\$150); 20 Field Notebooks @ \$4.50 each (\$90); 3

Probeware – Hydromania Complete Bundle @ \$875 each (\$2625); 3 Ecology Field Kits - Carolina

Biological @ \$775 each (\$2325); 1 LaMotte Water Pollution Kit @ \$475 each (\$475); 3 LaMotte

Water Pollution Kit Refill @ \$188 each (\$564); 10 Total Coliform Test Kits @ \$85 each (\$850)

Other: Summer housing for students @ \$75 per week for 3 weeks \$900.

Context of Course in Curriculum & Impact on the Institution

Our goal is to engage students in the scientific enterprise with this service-learning course.

There is a great deal of interest in producing service-learning courses that will create strong

partnerships between the university and surrounding community. The UR Education Department

currently runs an innovative educational program (*Math Science Investigators – MSI-Richmond*).

MSI-Richmond is supported by a grant from Philip Morris USA, and brings together UR students

to serve as tutors in science and math classes of Chandler Middle School. *MSI-Richmond* helps

promising students from Richmond Public Schools prepare for advanced placement and honors

classes in math and science by attending six weeks of classes at the university after their 8th grade

year. To better prepare students for *MSI-Richmond* and link these two programs, we will focus

Marine Biology of the Chesapeake Bay on one of the 5th grade classes (A. V. Norrell) that moves

on to Chandler. Our objective is to encourage students to stay on the college track by providing an

exciting and enjoyable science experience. *Marine Biology* will become a permanent part of UR's curriculum and Richmond Public School system.

Evidence of Institutional support

Members of the University of Richmond community have expressed a willingness to donate their time and energy in developing this project. Letters of support can be found attached to the hard copy document. Dr. Cathy Fisher is Director of the Teacher Licensure Program and will assist with the successful development of teacher workshops during the reflective phase of the grant. Dr. Patricia Stohr-Hunt is Chair of the Education Department and Director of Teacher Education. She has extensive experience in science education at the elementary level. Dr. Stohr-Hunt will discuss good teaching practices with students in the Marine Biology course and will assist with any curricular development. The chair of the Biology Department, who teaches our *Oceanography* course, is especially interested in seeing this course succeed and has voiced interest in teaching in the course in the future. Ms. Sue McGinnis will support all web design aspects of curricular development associated with Vern. Dr. Doug Hicks, director of The Bonner Center for Civic Engagement has indicated strong support for this project (see letter of endorsement).

Evaluation, Dissemination, and Continued Support

Reflection Phase

Following in-class and outdoor activities, the 4 members of the *Marine Biology* class will remain on campus to answer questions posed by 5th grade students. The students will adopt the persona of *Vern* to do this. Additional site visits will take place for 2 weeks after the outdoor experience to assist students with reflective aspects of their field-work. We will also help create a series of appropriate tests to assess the level of mastery (in line with SOLs) 5th graders achieved.

We plan on hosting a workshop to evaluate the effectiveness of the activities performed during the year (e.g., Seifer and Holmes 2002). This will provide an opportunity to plan for future activities and disseminate results of the program to other interested teachers in the greater Richmond area (see letter of support from Dr. Fisher). Teachers from the partner school and other interested elementary school science teachers (≈ 18 total) will be invited to the workshop. The workshop will take place over one weekend and will begin approximately 2 weeks after the class field trips. We plan on including a Friday night dinner and discussion followed by a discussions of future directions and further planning. Field-based activities will take place on Saturday. The 4 students and the PI will organize and run this event. The students will keep journals of their activities and will be responsible for documenting all discussions and producing a synopsis of workshop ideas. The PI will synthesize all of the advice, suggestions and criticisms during the remainder of the summer as preparations are made for the next iteration of the program.

The UR will implement a teacher-training program for any teacher interested in learning about the various forms of water quality monitoring that will be conducted during the year. In addition, the PI will ensure that results are presented at regional and national meetings and in leading

educational journals. We also plan on presenting our results to local school boards (Henrico, Hanover, Goochland, and Powhatan Counties) to talk about the importance of the outdoor experience and focus on the Bay watershed in elementary school.

One of the future goals for this program is to re-apply for funds from the NOAA Bay Watershed Education Training Program (B-WET) (see Disclosure statement below). While funds from the B-WET program are not necessary to ensure continued support and growth of this program, they represent a natural extension of the objectives of the *Marine Biology* course. Educators from NOAA, the city of Richmond, and UR have all indicated that they are interested in seeing this program succeed.

Literature Cited

Bachofer S, Martinelli PC (2005) Renewable Environment: Transforming Urban Neighborhoods. The SENCER Model Series 2005.

(http://www.sencer.net/pdfs/Models_Print_Web_2005/Renewable_Environments_Model.pdf)

Billig S, Furco A (2002) Service-Learning: The Essence of the Pedagogy. Greenwich, CT: Information Age Publishing.

Colby A, Ehrlich T, Beaumont E, Stephens J (2003) Educating Citizens: Preparing America's Undergraduates for Lives of Moral and Civic Responsibility Jossey-Bass, Indiana.

Eyler JS, Giles DE, Stenson CM, Gray CJ. (2001) At a Glance: What We Know About the Effects of Service-Learning on College Students, Faculty, Institutions and Communities, 1993-2000. 3rd Edition. Washington, DC: Corporation for National and Community Service.

Jacoby B (2003) Building Partnerships for Service-Learning. Jossey Bass, San Francisco.

Nybakken JW, Bertness MD (2004) Marine Biology: An Ecological Approach. Pearson Benjamin Cummings, San Francisco, CA.

Pierce AL, Burbank G, Abraham B, Davis J (2005) Riverscape. The SENCER Model Series 2005. (http://www.sencer.net/pdfs/Models_Print_Web_2005/Riverscape_Model.pdf)

Seifer SD, Holmes S (2002) Tools and Methods for Evaluating Service-Learning in Higher Education. National Service-Learning Clearinghouse Fact Sheet.

Siebert ED (2004) Environmental Literacy and Decision Making - An Interdisciplinary Goal for the 21st Century. Society for College Science Teachers. Symposium Proceedings

(<http://www.sencer.net/pdfs/Others/SCSTSENCERProceedings.pdf>)

CV of Faculty Participants:

Malcolm S. Hill

Education

University of Houston, Houston, TX Ph.D. 1996 Ecology
Colby College, Waterville, ME B.A. 1990 Biology: Environmental Science

Positions Held

University of Richmond, VA 2005-present Associate Professor of Biology
Fairfield University, Fairfield, CT 1997-2005 Asst. & Assoc. Professor of Biology

Courses Taught

University of Richmond – 2004-06

Integrative Biology; Ecology (with Lab); Tropical Marine Biology (with Lab & field experience in Belize)

Fairfield University – 1997-2004

Courses for Majors

General Biology (with lab); Seminar in Experimental Ecology; Genetics (lab); Evolutionary Biology (with lab); Research Advisor to ≈20 students (students have gone on to graduate, medical and dental schools, and careers in research and teaching)

Courses for Non-Majors

Introduction to Marine Science; Introduction to Environmental Science; Philosophy & Biology of Evolutionary Theory; Introduction to Evolutionary Biology; Honors: Minds and Bodies

Selected Recent Research Publications

Hill MS, Hill AL, Lopez N, Harriott O Sponge-specific bacterial symbionts in the Caribbean sponge, *Chondrilla nucula* (Demospongiae, Chondrosida). *Marine Biology* (*in press*)

Hill MS, Lopez N*, K Young* (2005) Antipredator defenses in four temperate sponges of the western North Atlantic: Evidence for a defensive synergism in *Microciona prolifera*. *Marine Ecology Progress Series* 291: 93-102

Hill AL, A Wagner*, MS Hill (2003) Hox and paraHox genes from the anthozoan *Parazoanthus parasiticus* *Molecular Phylogenetics and Evolution* 28: 529-535.

Hill MS, AL Hill (2002) Morphological plasticity in the tropical sponge *Anthosigmella varians*: Responses to predators and wave energy. *Biological Bulletin* 202: 86-95.

* Fairfield University undergraduates

Selected Pedagogical Publications

Landolfi C*, S Siddiqui*, O Harriott, M Hill (2002) Prokaryotic symbionts harbored by a marine sponge. *MicrobeLibrary* (<http://www.microbelibrary.org/>) MicroLibrary is an on-line, peer-reviewed curriculum resource of the American Society for Microbiology.

Hill MS, AL Hill (2000) Freshwater sponges as indicators of water pollution: an investigative undergraduate lab. *Lababstracts* 22: 2-5. (<http://www.zoo.utoronto.ca/~able/>) On-line publication of the Association for Biology Laboratory Education.

Hill MS, O Harriott, AL Hill (2000) Exploring symbiotic microbial diversity in marine sponges. *MicrobeLibrary*. (<http://www.MicrobeLibrary.org/>) MicroLibrary is an on-line, peer-reviewed curriculum resource of the American Society for Microbiology.

* Fairfield University - undergraduates

Selected Presentations

Invited speaker at the 2004 annual meeting American Society for Microbiology – “Innovations in Education: Using the web to improve you teaching.” New Orleans, LA. May ‘04

Keynote speaker “Course Redesign in Action: Campus Perspectives in Biology” Academic Efficiencies Workshop for Mathematics and Ecology Faculty. Oklahoma Board of Regents, Oklahoma City, OK. February ‘04

Plenary Speaker “Biology Course Redesign” Northeast Conference on Incorporating IT in Curricular Redesign at Seton Hall University, South Orange, NJ. May ‘04

"Sponges as bioindicators" with A Hill. Association of Biology Laboratory Education. University of Chicago. June ‘01

"Redesign of General Biology: A Progress Report." Pew Center for Academic Transformation Workshop. San Antonio, TX. March ‘01.

Selected Grants and Awards

Nominated to the Danforth Associates of New England (DANE) by the President of Fairfield University. May 2003

National Computational Science Institute – Sigma Xi “Workshop for use of computer models in the classroom.” – Grant to support the visit of an educator from the Shodor Education Foundation. 2002

Council on Undergraduate Research, Summer Research Fellowships: “Morphological and chemical defenses in marine sponges: ecological and evolutionary perspectives.” 2002 & “Examination of larval size plasticity and paternal reproductive success in the brooding sponge *Haliclona loosanoffi* from high and low water circulation environments.” 1999

Pew Center for Academic Transformation grant application. Project Title: "The Redesign of General Biology" 2000-02 Lead author and project director.

Co-PI with team from Biology and Chemistry on grant from Merck/American Association for the Advancement of Science Undergraduate Science Research Program 2000-2002.

Laboratory Teaching Initiative Grant from the American Biology Laboratory Education Scholarship Committee "Freshwater sponges as bioindicators: An undergraduate investigative lab involving morphological and molecular bioassays." 1999

Disclosure Statement

There are no ongoing or pending grants that will coincide with the submitted proposal. This project originated as part of a more expansive proposal that was submitted to the Bay Watershed Education Training program sponsored by the National Oceanographic and Atmospheric Administration. Although we recently learned that the grant was not funded, the reviews were extremely positive and the program officers strongly encouraged a resubmission. Reviewers suggested that a pilot program be conducted to develop the undergraduate course and develop relationships with a single elementary school as proof-of-concept. The proposal submitted to ACS follows from those comments. All of the participants in the B-WET grant have voiced continued support for the course proposal included here. Our future goals include submission of another B-WET grant (for FY2007) after we establish a successful undergraduate course and partnership with A. V. Norrell school. The project proposed for this ACS Science Reform Program grant application will enable us to cultivate a strong course that will attract additional funding and expand and grow well into the future.