

DRAFT

**Program Proposal for B.S.
in Integrated
Environmental Sciences**

Longwood University

3/9/2012

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I. Letter from VPAA

Note: Letter pending upon program approval by EPC.

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**STATE COUNCIL OF HIGHER EDUCATION FOR VIRGINIA
PROGRAM PROPOSAL COVER SHEET**

1. Institution <div style="border: 1px solid black; padding: 2px; margin-top: 5px;">Longwood University</div>	2. Program action (Check one): New program proposal <input checked="" type="radio"/> Spin-off proposal <input type="radio"/> Certificate proposal <input type="radio"/>
3. Title of proposed program <div style="border: 1px solid black; padding: 2px; margin-top: 5px;">Integrated Environmental Sciences</div>	4. CIP code <div style="border: 1px solid black; padding: 2px; margin-top: 5px;">3.0104</div>
5. Degree designation <div style="border: 1px solid black; padding: 2px; margin-top: 5px;">B.S.</div>	6. Term and year of initiation <div style="border: 1px solid black; padding: 2px; margin-top: 5px;">Fall 2013</div>
7a. For a proposed spin-off, title and degree designation of existing degree program <div style="border: 1px solid black; height: 20px; margin-top: 5px;"></div>	
7b. CIP code (existing program) <div style="border: 1px solid black; height: 20px; margin-top: 5px;"></div>	
8. Term and year of first graduates <div style="border: 1px solid black; padding: 2px; margin-top: 5px;">S 2017</div>	9. Date approved by Board of Visitors <div style="border: 1px solid black; height: 20px; margin-top: 5px;"></div>
10. For community colleges: date approved by local board <div style="border: 1px solid black; width: 150px; margin-top: 5px;"></div> date approved by State Board for Community Colleges <div style="border: 1px solid black; width: 200px; margin-top: 5px;"></div>	
11. If collaborative or joint program, identify collaborating institution(s) and attach letter(s) of intent/support from corresponding chief academic officers(s) <div style="border: 1px solid black; height: 30px; margin-top: 5px;"></div>	
12. Location of program within institution (complete for every level, as appropriate). Departments(s) or division of <div style="border: 1px solid black; padding: 2px; margin-top: 5px;">Biological and Environmental Sciences</div> School(s) or college(s) of <div style="border: 1px solid black; padding: 2px; margin-top: 5px;">Cook-Cole College of Arts & Sciences</div> Campus(es) or off-campus site(s) <div style="border: 1px solid black; padding: 2px; margin-top: 5px;">Main Longwood Campus</div> Distance Delivery (web-based, satellite, etc.) <div style="border: 1px solid black; height: 20px; margin-top: 5px;"></div>	
13. Name, title, telephone number, and e-mail address of person(s) other than the institution's chief academic officer who may be contacted by or may be expected to contact Council staff regarding this program proposal. <div style="border: 1px solid black; padding: 5px; margin-top: 5px;">Dr. Mark Fink, Chair Dept. of BES, 434-395-2749, finkml@longwood.edu</div>	

III. Program Overview

Location – Sponsoring Unit

Longwood University requests approval to initiate a Bachelor of Science degree in Integrated Environmental Sciences. The proposed program will be administered by the Department of Biological and Environmental Sciences and the Cook-Cole College of Arts and Sciences. The program is to be implemented in the fall of 2013.

Purpose and Background

This is a proposal to offer an undergraduate program that prepares its graduates for a successful career in the diverse field of environmental science. The effects of human activities in the environment have been receiving increasing attention over the past few decades. While this awareness has often taken the form of popular media, the scientific community has steadily observed the impacts of human actions on many aspects of the earth system including the atmosphere, biosphere, hydrosphere, and geosphere.

From local to global scales, scientists and technicians who study our environment have been and will remain crucial to elucidating the interconnections between the biological and physical world, the understanding of which requires knowledge of biology, geology, chemistry, meteorology, atmospheric science, etc. As if those are not complex enough, these scientists must understand the impacts of human actions on these processes, and the human systems – policy, law, and education, for example – that are employed to manage activities and impacts. For this reason, environmental science is inherently an interdisciplinary field of study and cannot be fully appreciated by only studying one component. Accordingly, this proposal sets forth a new interdisciplinary undergraduate major in integrated environmental sciences. This major will provide students with an understanding of the underlying science of our environment and the role of human actions. As noted in several of the accompanying letters of support (Appendix A), there is a need for well-trained scientists who can navigate these complex problems and move easily between scientific and social contexts. For this reason, a degree in integrated environmental sciences would strengthen the ability of Longwood University students to serve as citizen leaders whether they assist in their local community or our global community.

Furthermore, the proposed degree program is a response by Longwood University to calls for new opportunities for students to pursue STEM (science, technology, engineering, and mathematics) careers. Governor McDonnell's Commission on Higher Education Reform, Innovation, and Investment, in its "Preparing for the top jobs for the

21st century” report (HERII 2010), calls for the Commonwealth’s higher education system to provide learning opportunities for more students, particularly in the STEM fields. “Closely connected to the 100,000-degree goal is Virginia’s crucial focus on raising educational attainment in high-demand, high-earning disciplines, such as science, technology, math, science and healthcare” (HERII 2010, page 30). The Commission notes that, “Virginia will need to prepare 100,000 additional workers with STEM degrees over the next decade,” (HERII 2010, page 35), and data in this program proposal indicate clearly that there are increasing employment opportunities for environmental science professionals across the Commonwealth.

In addition to serving as a response to our Governor’s call to action, this proposal also responds to national calls to action, most notably the “Gathering Storm” report by the National Academies of Sciences (NAS 2007). The authors note a key obstacle to achieving success in the production of more STEM majors and thus more STEM professionals: The nation faces several areas of challenge: K–12 student preparation in science and mathematics, limited undergraduate interest in science and engineering majors, significant student attrition among science and engineering undergraduate and graduate students, and science and engineering education that in some instances inadequately prepares students to work outside universities” (NAS 2007, page 94). In designing this interdisciplinary degree program, we have sought to employ best practices for engaging students in scientific learning, practices that are thought to improve recruitment into science programs and also retention within those programs (Beck et al. 2007), particularly for historically underrepresented groups (e.g., College of William and Mary program focused on interdisciplinary science that is funded by the Howard Hughes Medical Institute). The proposed program not only seeks to provide additional STEM opportunities but to employ strategies that will facilitate recruitment of new populations of students to the program and support their retention in it.

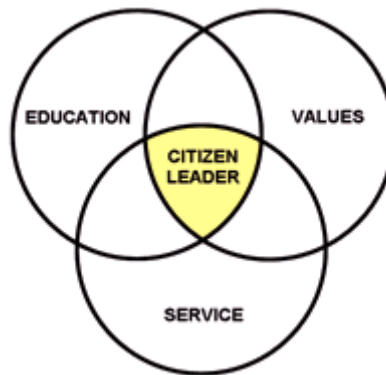
University Mission and Vision

Mission. Longwood University is an institution of higher learning dedicated to the development of citizen leaders who are prepared to make positive contributions to the common good of society. Building upon its strong foundation in the liberal arts and sciences, the University provides an environment in which exceptional teaching fosters student learning, scholarship, and achievement. As the only four-year public institution in south central Virginia, Longwood University serves as a catalyst for regional prosperity and advancement.

Vision. Longwood University will transform capable men and women into citizen leaders, fully engaged in the world around them. The University will be a first choice institution renowned for developing the power of citizen leadership in its students for the benefit of the greater community.

What is a Citizen Leader?

Citizen leaders are the bedrock of the democracy. They are the reasons communities thrive. They are the people who make the United States of America what it wants to be. They make our nation work. They care and they equip themselves with the tools to bring their caring to life in the world. A citizen leader effectively combines three components of a joy-filled life.



Education: The citizen leader is a lifelong learner and stays connected to what is new in the world. Faculty are encouraged and rewarded for contributing to scholarship as well as for their service as teachers.

Values: Citizen leaders know their values and live by them. Honesty, equality, civility, duty and an appreciation of the differences among peoples are fundamental values. To these, the citizen leader adds the personal values that define him or her.

Service: The capstone of every great civilization has always been a commitment to serve others. It is a common precept of the world's great religions; it is one of the finest expressions of our humanity. To the citizen leader, service is not just an extracurricular activity.

(Longwood University 2012, <http://www.longwood.edu/president/4731.htm>)

IV. Justification

General Demand

National trends

According to the U.S. Department of Labor's Bureau of Labor Statistics, "...employment of environmental scientists and specialists is projected to grow by 19 percent from 2010 to 2020." The Bureau cites "...heightened public interest in the hazards facing the environment, as well as the increasing demands placed on the environment by population growth" as the root causes that will increase demand for environmental scientists. The Bureau further states that demand for environmental scientists in private consulting firms and government agencies is expected to grow as result of "...new and increasingly complex environmental laws and regulations." These laws will require businesses and local governments to hire or consult with environmental scientists to prevent pollution, conserve resources, minimize waste and stay in compliance (BLS 2012).

According to a report by Harrisburg University of Science and Technology (HUST 2012) based on employment projections of the U.S. Bureau of Labor Statistics, the number of science-related jobs will increase at a rate faster than the national average between now and 2016. Based on projected job growth, of the Top 10 Careers in Science and Biotech, environmental scientists rank number one on the list followed by related occupations of hydrologists, geoscientists, and atmospheric scientists (ranked 2, 3, and 6, respectively). See Section IV, Employment Demand, below for detailed job growth projections.

Additionally, the Association for Environmental Studies and Sciences (AESS 2009) reports high demand for graduates of environmental science and studies programs and increasing student interest nationally. The majority of environmental science and studies programs report enrollment growth from 2003-08 and evidence suggests this trend is accelerating.

A 2009 article published by *The New York Times* (Galbraith 2009) identified environmental sciences and studies as an area of strong growth in colleges and universities across the nation.

Student Demand

Student demand was assessed through three surveys conducted by Longwood, general interest surveys conducted by the College Board and the National Research Center for College & University Admissions, enrollment trends at Virginia institutions, national enrollment trends, and student correspondence. All sources indicate strong and

increasing student interest in environmental science, both in general and as a program at Longwood University.

Interest in Environmental Sciences at Longwood University

Longwood admissions officers are routinely asked at LU recruiting events and Open Houses about the availability of an environmental science major at Longwood. Similar student inquiries are also regularly received by the Department of Biological and Environmental Sciences. Please see Appendix B for examples of correspondence from students expressing interest in an environmental science major at Longwood University.

We conducted three distinct surveys to document interest in an Integrated Environmental Sciences program at Longwood. Results in brief are reported below; surveys in their entirety are reported in Appendix C.

Survey Results

1. Survey of students accepted to Longwood for fall 2012 indicating an interest in a science or undeclared major. The survey was conducted in February 2012.

Of the 66 students responding to this survey, 84.8% indicated interest in attending Longwood.

I am interested in attending Longwood University.

	Response Percent	Response Count
Agree	34.8%	23
Strongly agree	50.0%	33

Of the 66 students responding to this survey, 28.8% indicated interest in attending Longwood and majoring in environmental science.

If Longwood University offered a major in Environmental Science, I would be interested in attending Longwood and majoring in Environmental Science.

	Response Percent	Response Count
Agree	15.2%	10
Strongly agree	13.6%	9

See Appendix C for the complete survey and results.

2. Survey of prospective college students currently attending Virginia high schools. Students surveyed will enter college in fall 2013 and beyond. This survey was conducted in February 2012.

Of the 165 students responding to this survey, 61.8% indicated interest in attending Longwood.

I am interested in attending Longwood University.

	Response Percent	Response Count
Agree	30.3%	50
Strongly agree	31.5%	52

Of the 164 students responding to this survey, 22.5% indicated interest in attending Longwood and majoring in environmental science.

If Longwood University offered a major in Environmental Science, I would be interested in attending Longwood and majoring in Environmental Science.

	Response Percent	Response Count
Agree	19.5%	32
Strongly agree	3.0%	5

See Appendix C for the complete survey and results.

3. Survey of current Longwood students with an Undeclared major. The survey was conducted in February 2012.

Of the 39 students responding to the survey, 33.3% indicated interest in this major.

If Longwood University offered a major in Environmental Science, I would be interested in majoring in Environmental Science.

	Response Percent	Response Count
Agree	12.8%	5
Strongly agree	20.5%	8

Of the 39 students responding, 35.9% indicated they would have been interested in this major if it had been offered when they arrived at Longwood.

If Longwood University had offered an Environmental Science major before I arrived, I would have been interested in Environmental Science.

	Response Percent	Response Count
Agree	25.6%	10
Strongly agree	10.3%	4

See Appendix C for the complete survey and results.

Interest in Environmental Sciences and Studies in Virginia

Students currently enrolled in secondary education programs in Virginia are expressing increased interest in environmental science majors. The data reported below are from the College Board (<http://www.collegeboard.org/>) surveys of Virginia high school students and indicate an increasing trend in interest in environmental science.

Students indicating environmental science as their top choice of college major:

2011 graduates - 232
2012 graduates - 325 (this population is still being surveyed, so will likely increase)
2013 graduates - 296 (this population is still being surveyed, so will likely increase)
2014 graduates - 188 (this population is still being surveyed, so will likely increase)

Students indicating environmental science as their top 5 career choice

2011 graduates - 429
2012 graduates - 656 (this population is still being surveyed, so will likely increase)
2013 graduates - 330 (this population is still being surveyed, so will likely increase)

In comparison, we report below College Board student survey results for several existing majors at Longwood which we predict will be comparable in size to the Integrated Environmental Sciences major at Longwood:

2011 graduates - 325 expressed interest in Mathematics (16 were enrolled at LU)
2012 graduates - 455 are expressing interest in Mathematics (18 have enrolled)
2011 graduates - 74 expressed interest in Physics (26 were enrolled at LU)
2011 graduates - 66 expressed interest in Chemistry (10 were enrolled at LU)

Additionally, survey results of Virginia high school students by the National Research Center for College & University Admissions (NRCCUA; <http://www.nrccua.org/cms>) further demonstrate increasing interest in environmental science majors in Virginia. A total of 5884 high school students graduating between 2009 and 2012 indicated strong interest in environmental science careers.

2009 graduates – 1233 students
2010 graduates – 1391 students
2011 graduates – 1611 students
2012 graduates – 1649 students

As noted in Section IX of this document (Duplication), enrollments in the 12 environmental science and studies programs currently offered at Virginia public and private 4-year institutions have been increasing in recent years.

Employment Demand

Environmental Science is a diverse and rapidly growing field that encompasses a variety of professions and career opportunities. Listed below are employment projections for several fields encompassed by environmental science. Federal statistics are reported from the 2010-11 edition of the Bureau of Labor Statistics' Occupational Outlook Handbook (OOH 2010). Virginia statistics are reported from Virginia Career View (VCV 2012).

Environmental Scientists and Specialists

Federal. (<http://www.bls.gov/oco/ocos311.htm>)

- 85,900 jobs in 2008. An additional 6,200 jobs held by environmental science faculty.
- 109,800 jobs projected in 2018 (28% increase).
- Employment is expected to grow much faster than the average for all occupations.
- A bachelor's degree is sufficient for most jobs in government and private sector companies.

Virginia. (<http://www.vaview.vt.edu/careers/career/19-2041.00/Proj>)

- 3,192 jobs in VA in 2008.
- 4,296 VA jobs projected in 2018 (34.6% increase).

- Regional growth: Hampton Roads (22%), Richmond (17%), Piedmont (25%), Shenandoah Valley (23%), Northern VA (43%), Western VA (14%), New River (9%), Greater Peninsula (28%).

Environmental Science and Protection Technicians

Federal. (<http://www.bls.gov/oco/ocos115.htm>)

- 35,000 jobs in 2008.
- 45,200 jobs projected in 2018 (29% increase).
- Employment is expected to grow much faster than the average for all occupations.

Virginia. (<http://www.vaview.vt.edu/careers/career/19-4091.00/Proj>)

- 471 jobs in VA in 2008.
- 623 VA jobs projected in 2018 (32.3% increase).
- Regional growth: Hampton Roads (20%), Richmond (13%), Northern VA (37%), Western VA (37%), New River (72%).

Geoscientists and Hydrologists

Federal. (<http://www.bls.gov/oco/ocos312.htm>)

- 41,700 jobs in 2008.
- 49,100 jobs projected in 2018 (18% increase).
- Employment is expected to grow much faster than the average for all occupations.

Virginia. (<http://www.vaview.vt.edu/careers/career/19-2042.00/Proj>),
(<http://www.vaview.vt.edu/careers/career/19-2043.00/Proj>)

- 589 geoscientist and 116 hydrologist jobs in VA in 2008.
- 735 geoscientist and 140 hydrologist jobs in VA projected in 2018 (24.8% and 20.7% increases, respectively).

Atmospheric Scientists

Federal. (<http://www.bls.gov/oco/ocos051.htm>)

- 9,400 jobs in 2008.
- 10,800 jobs projected in 2018 (15% increase).
- Employment is expected to grow much faster than the average for all occupations.

Virginia. (<http://www.vaview.vt.edu/careers/career/19-2021.00/Proj>)

- 48 atmospheric scientist jobs in VA in 2008.
- 51 atmospheric scientist jobs in VA jobs projected in 2018 (6.3% increase)

Conservation Scientists and Foresters

Federal. (<http://www.bls.gov/oco/ocos048.htm>)

- 29,800 jobs in 2008.
- 33,400 jobs projected in 2018 (12% increase).
- Employment is expected to grow about as fast as average for all occupations.

Virginia. (<http://www.vaview.vt.edu/careers/career/19-1031.00/Proj>),
(<http://www.vaview.vt.edu/careers/career/19-1032.00/Proj>)

- 383 Conservation Scientist and 322 Forester jobs in VA in 2008.
- 444 Conservation Scientist and 326 Forester jobs in VA projected in 2018 (15.9% and 1.2% increases, respectively).

Potential Job Opportunities

Numerous agencies, organizations, and businesses within the Commonwealth employ or potentially employ environmental scientists, including:

- Agriculture and Consumer Services (Department of)
- Alliance for the Chesapeake Bay
- Chesapeake Bay Commission
- Chesapeake Bay Foundation
- Chesapeake Bay Local Assistance Department
- Chesapeake Bay Program
- Conservation and Recreation (Department of)
- Cooperative Extension Service
- Corporations' environmental management and compliance departments
- Drinking Water Office
- Emergency Management (Department of)
- Energy Management (Department of)
- Environmentally-focused community organizations (e.g., Arlingtonians for a Clean Environment, Clean Valley Council in Roanoke, Hampton Clean Community, Rivanna River Basin Commission, Elizabeth River Project)
- Environmental Quality (Department of)

- Forestry (Department of)
- Friends groups (Friends of the Potomac, Rappahannock, and Shenandoah Rivers)
- Game and Inland Fisheries (Department of)
- Geographic Information Network
- Hampton Roads Sanitation District Commission
- Health (Department of)
- Historic Resources (Department of)
- James River Association
- Local governments' stormwater management, public works, waste management and pollution prevention departments
- Marine Products Board
- Marine Resources Commission
- Mines, Minerals, and Energy (Department of)
- Private-sector consulting firms specializing in environmental engineering, planning, compliance and management
- Regional waste management authorities
- Science Museum of Virginia
- Soil and Water Conservation (Department of)
- State Parks (Department of)
- Transportation (Department of)
- Various regional planning district commissions
- Virginia Aquarium
- Virginia Coalfield Economic Development Authority
- Virginia Museum of Natural History
- Virginia Resources Authority
- Virginia Rivers' Roundtable groups
- Waste management and recycling companies

Additionally, numerous agencies and organizations within the federal government employ or potentially could employ environmental scientists, including:

- Department of Agriculture
 - Forest Service
 - Natural Resource Conservation Service
- Department of Commerce
 - National Marine Fisheries Service
 - National Ocean Service
 - National Oceanographic and Atmospheric Administration
 - National Weather Service

- Office of Oceanic and Atmospheric Research
- Department of Defense
 - Army Corps of Engineers
 - Army Environmental Center
 - Defense Environmental Network and Information Exchange
 - Defense Logistics Agency
 - Installations and Environment
 - National Defense Center for Environmental Excellence
- Department of Energy
 - Office of Civilian Radioactive Waste Management
 - Office of Energy Efficiency and Renewable Energy
 - Office of Health, Safety, and Security
- Department of Health and Human Services
 - Agency for Toxic Substances and Disease Registry
 - Centers for Disease Control and Prevention
- Department of Homeland Security
 - Federal Emergency Management Agency
 - US Coast Guard
- Department of the Interior
 - Bureau of Reclamation
 - Bureau of Land Management
 - Minerals Management Service
 - National Park Service
 - Office of Environmental Policy and Compliance
 - Office of Surface Mining Reclamation and Enforcement
 - US Fish and Wildlife Service
 - US Geological Survey
- Department of Justice
 - Environmental and Natural Resources Division
- Department of Labor
 - Mine Safety and Health Administration
- Environmental Protection Agency
- National Aeronautics and Space Administration
- National Science Foundation

Also, there are many national non-profit organizations, many of them based in the metropolitan Washington D.C. area, that employ or potentially could employ environmental scientists, including:

- Ducks Unlimited

- Nature Conservancy
- National Audubon Society
- National Geographic Society
- National Wildlife Federation
- Ocean Conservancy
- Ocean Foundation
- Quail Unlimited
- The Wildlife Society
- World Wildlife Fund

Current Job Openings in Virginia

We have documented over 37 current job openings in Virginia for candidates with a Bachelor of Science degree in Environmental Science. Thirteen of these are entry level positions requiring a B.S. degree in environmental science with no experience required. Eight additional positions preferred 1-2 years of experience, while 16 other positions required 3 or more years of experience. Employers include the U.S. Marine Corps, the Department of Defense, the Department of the Interior, the National Park Service, and the Office of Naval Research. The varied positions include park guides and rangers, conservation specialists, oceanographers, sustainability coordinators, geologists, and environmental scientists among others. See Appendix D for a sample listing and summary of recent employment opportunities in Virginia for which no experience other than a B.S. degree is required.

V. Description of Proposed Program

Admissions, continuation, exit requirements

Admission decisions are handled by the Office of Admissions. Admission to Longwood University is competitive. Guidelines for admission to the B.S. program in Integrated Environmental Sciences will follow the general admission policy approved by the Longwood University Board of Visitors. For continuation in the major, students must earn a minimum grade of C- in all integrative courses listed under the integrated environmental sciences major requirements (Section VI, Part C3). Students will exit the program following successful completion of 120 credit hours.

Time to degree

Students in the Integrated Environmental Sciences major will be able to complete the program in 8 semesters or semester equivalents. Time to completion is based on a full-time student enrolling in an average of 15 credit hours per semester. Students have the opportunity to enroll in numerous online and standard courses held during Longwood's summer and winter sessions. The proposed program can be completed with successful completion of 120 credit hours. See Appendix E for a sample plan of study for a full-time student in the Integrated Environmental Sciences major.

Target Population

The major in Integrated Environmental Sciences will target students who are interested in STEM areas but are looking for a more integrated and interdisciplinary approach than traditional STEM fields offer. We anticipate this major will attract students with a wide range of interests and career goals, including those who wish to pursue environmental careers from a more purely science-oriented approach to those seeking a more applied approach to the environmental sciences. The integrative nature of the major is designed to develop skill sets and critical thinking across both the "hard" and "soft" sciences while giving students the opportunity to tailor their courses toward their specific interests. Students may elect to pursue one of four concentrations in the major (Life Sciences, Physical Sciences, Earth Sciences, or Social Sciences) or design an individualized concentration to best meet the student's objectives for professional preparation (See Section VI, Curriculum Description).

VI. Curriculum Description

The proposed major requires a total of 120 credit hours. The curriculum will include 38 credits of general education courses, 7 credits of additional requirements for the Bachelor of Science degree, 61-69 credits of major requirements, and 6-14 credits of general electives.

INTEGRATED ENVIRONMENTAL SCIENCES MAJOR, BS DEGREE

A. General Education Core Requirement/38 credits

- Goal 1: LSEM 100 Longwood Seminar/1 Credit
- Goal 2: ENGL 150 Writing and Research/3 credits
- Goal 3: Literature elective/3 credits
- Goal 4: Arts elective/3 credits
- Goal 5: Math elective/3 credits (MATH 171 is recommended)
- Goal 6: Natural Sciences elective/4 credits (PHYS 103 is recommended)
- Goal 7: Western Civilization elective/3 credits
- Goal 8: Social Sciences elective/3 credits
- Goal 9: Diversity elective/3 credits
- Goal 10: Foreign Language elective/3 credits
- Goal 11: Physical Activity elective/2 credits
- Goal 12: Ethics elective/3 credits (PHIL 316 Environmental Ethics is required)
- Goal 13: Active Citizenship elective/3 credits
- Goal 14: Experiential Learning elective/1 credit (ENSC 492 Internship in Environmental Science or 496 Research in Environmental Science is required)

B. Additional B.S. Degree Requirements/7 credits

- MATH 301 Applied Statistics/3 credits
- CHEM 111 Fundamentals of Chemistry I /4 credits

C. Major Requirements/61-69 credits (plus the 15 credits counted in General Education and Additional Degree Requirements)

1. CORE COMPETENCIES/26 credits (plus the 8 credits counted in General Education and Additional Degree Requirements)

Life Sciences

- BIOL 122 Diversity of Life/4 credits
- BIOL 341 General Ecology/4 credits

Physical Sciences

- CHEM 111 Fundamentals of Chemistry I/4 credits (satisfied by Additional Degree Requirements)
- CHEM 112 Fundamentals of Chemistry II/4 credits

PHYS 103 Conceptual Physics/4 credits (satisfied if taken as General Education Goal 6)

Earth Sciences

EASC 211 Environmental Geology/4 credits (**new course**)

EASC 212 Atmospheric Science/4 credits (**new course**)

Social Sciences

Choose two courses from the following:

ECON 314 Environmental and Resource Economics/3 credits

SOCL 260 Environment and Society/3 credits

ENSC 380 Introduction to Environmental Law and Policy/3 credits (**new course**)

GEOG 241 Cultural Geography/3 credits

2. SKILLS/7 credits (plus the 6 credits counted in General Education and Additional Degree Requirements)

GEOG 275 Introduction to GIS/4 credits

COMM 101 Public Speaking/3 credits

MATH 171 Statistical Decision Making/3 credits (satisfied if taken as General Education Goal 5)

MATH 301 Applied Statistics/3 credits (satisfied by Additional Degree Requirements)

3. INTEGRATIVE COURSES/16 credits (plus the 1 credit counted in General Education)

ENSC 101 Introduction to Integrated Environmental Sciences/2 credits (**new course**)

ENSC 201 Integrated Environmental Investigations/4 credits (**new course**)

ENSC 340 Global Environmental Issues/3 credits (**new course**)

ENSC 401 Environmental Planning and Management/4 credits (**new course**)

ENSC 402 Environmental Decision Making/3 credits (**new course**)

ENSC 492 Internship in Environmental Science/1 credit (satisfied by General Education Goal 14)

OR ENSC 496 Research in Environmental Science/1 credit (satisfied by General Education Goal 14)

4. ENVIRONMENTAL SCIENCE ELECTIVES/12-20 credits

Choose four elective courses in one of the approved concentrations listed below (Life Sciences, Physical Sciences, Earth Sciences, or Social Sciences).

Alternatively, a student may design an individualized concentration to best meet the student's objectives for professional preparation. An individualized concentration must be developed in consultation with the student's advisor and approved by the Department of Biological and Environmental Sciences' Curriculum Committee.

Life Sciences Concentration

Choose four of the following courses:

BIOL 304	Microbiology/5 credits
BIOL 342	Terrestrial Biogeography/4 credits
BIOL 361	Aquatic Ecology/5 credits
BIOL 430	Conservation Biology/4 credits
BIOL 435	Advanced Ecology/4 credits
BIOL 443	Field Botany/6 credits
BIOL 445	Tropical Ecology/4 credits
BIOL 471	Ornithology/4 credits
BIOL 474	Entomology/4 credits

Physical Sciences Concentration

Choose four of the following courses (lecture and lab combination counts as one course):

CHEM 305 and 307	Organic Chemistry I (lecture + lab) /4 credits
CHEM 306 and 308	Organic Chemistry II (lecture + lab) /4 credits
CHEM 350	Quantitative Analysis/4 credits
CHEM 351	Instrumental Analysis/3 credits
CHEM 372	Environmental Chemistry/3 credits

Earth Sciences Concentration

Choose four of the following courses:

EASC 261	Meteorology/4 credits
EASC 354	Hydrology/3 credits
EASC 355	Climatology/3 credits
EASC 363	Physical Oceanography/4 credits
EASC 410	Geomorphology/3 credits
EASC 342	Terrestrial Biogeography/4 credits

Social Sciences Concentration

Choose four of the following courses:

ECON 314	Environmental and Resource Economics/3 credits*
SOCL 260	Environment and Society /3 credits*
ENSC 380	Environmental Law and Policy/3 credits*
GEOG 241	Cultural Geography/3 credits*
ANTH/SOCL 322	Sustainability/3 credits
GEOG 342	Terrestrial Biogeography/4 credits
GEOG 358	Map Design and Analysis/4 credits
GEOG 353	Geography of Virginia/3 credits
HIST 427	Latin American Environmental History/3 credits
HLTH 210	World Health Issues/3 credits
HLTH 400	Environmental Health/3 credits
RECR 420	Environmental Education Resources/3 credits

*ECON 314, SOCL 260, ENSC 380, and GEOG 241 may only be used to fulfill requirements in the Social Science Concentration if they were not taken to fulfill core competencies

Note: Credit hours for courses which are required or recommended for General Education Goals or Additional Degree Requirements are only counted in those areas (parts A and B). They are not double-counted in the credit hour total for Major Requirements (part C).

D. General Electives/6-14 credits

E. Total Credits Required for BS in Integrated Environmental Sciences/120 credits

Note: There are eight new courses, totaling 27 credit hours, that will be developed (noted in bold in the major requirements listing). The General Education Goal 14 listings of ENSC 492 and ENSC 496 are also technically new course listings for the new ENSC prefix, though these internship and research numbers are already approved for all disciplines at Longwood University and are developed on an individual student basis.

Note: Course descriptions for all new and existing courses within the major requirements are listed in Appendix F.

VII. Faculty

Overview

The Department of Biological and Environmental Sciences is a dynamic department of 12 tenure-track biology faculty, 4 tenure-track earth science and geography faculty, and 5 full-time non-tenure track faculty in biology and geography currently serving a Bachelor of Science program in Biology as well as minor programs in Biology, Environmental Studies, Earth Science, and Geography.

Two new tenure-track positions are being added to support the new major in Integrated Environmental Sciences. These positions were approved in Longwood's 6-year plan and are being funded from an \$885,000 base budget increase allocated to STEM and Health-related projects. The first hire will begin in fall 2012 and will be a biologist specializing in aspects of global environmental change. The second hire, beginning in fall 2013, will be an environmental scientist who will have strengths that complement those of faculty who are currently on staff.

In addition, as this major will have a strong interdisciplinary approach, the program will draw upon the contributions and expertise of current faculty members in departments outside of Biological and Environmental Sciences. Within the major requirements, students will complete coursework taught by faculty in the following academic departments: 1) Chemistry and Physics, 2) Sociology, Anthropology, and Criminal

Justice Studies, 3) Communication Studies and Theatre, 4) Accounting, Economics, Finance, and Real Estate, and 5) Health, Athletic Training, Recreation and Kinesiology.

Research

See Appendix G for abbreviated CVs of faculty in the Department of Biological and Environmental Sciences as well as other faculty who will contribute to the proposed program. Also included in Appendix H is a summary of faculty research productivity for 8 current faculty members in the Department of Biological and Environmental Sciences who will be closely associated with the new program.

VIII. Assessment

Integrated Environmental Sciences Assessment

The proposed B.S. in Integrated Environmental Sciences is a rigorous, integrated program of study designed to provide students with a strong foundation of the scientific and social processes that shape the Earth. Students completing this program will have the fundamental knowledge about how our world works and how our world is characterized as a set of interconnected physical, biological, and social systems. Further, students will be equipped with critical thinking skills to make well-reasoned decisions concerning environmental issues. Graduates will be prepared for employment in natural resource fields dealing with basic and applied scientific interests, environmental management and policy-making, or for graduate-level training.

Learning Goals and Outcomes

1. Develop an understanding how our world works as interconnected physical, biological, and social systems.
 - a. Outcome 1: Define the major scientific underpinnings of emerging environmental issues.
 - b. Outcome 2: Demonstrate fundamental scientific reasoning.
2. Develop the ability to collect, organize, and evaluate scientific information through experiential learning.
 - a. Outcome 3: Demonstrate an understanding of the basics of experimental design and analysis.
 - b. Outcome 4: Interpret data in scientific literature and other sources and draw valid conclusions.
 - c. Outcome 5: Demonstrate the ability to connect theory and practice through experiential and/or service learning.
3. Enhance the ability to communicate science effectively.
 - a. Outcome 6: Effectively write in a scientific context.
 - b. Outcome 7: Effectively communicate orally in a scientific context.

Assessment Plan

Measures	Target	Learning Outcomes	Cycle and Reviewers
Measure 1-Written Position Papers: In this assignment, students must provide a well-supported position on an environmental issue in each integrative course and compiled in electronic portfolios. This is a direct measure.	A numerical target will be developed using a grading rubric after the first assessment cycle.	1, 2, 3, 4, 6	A subset of the papers will be randomly selected from all of the integrative courses and independently evaluated by at least 2 faculty using a standard rubric. This will be done annually and reported at a faculty meeting.
Measure 2-Oral Presentation of Position Papers: Same as Measure 1 but in the two integrative courses that are speaking intensive, an oral presentation will also be made and videotaped. This is a direct measure	A numerical target will be developed using a grading rubric after the first assessment cycle.	1, 2, 3, 4, 7	A subset of the oral presentations will be randomly selected and independently evaluated by at least 2 faculty members using a standard rubric. This will be done annually and reported at a faculty meeting.
Measure 3-Field Exam: In the Capstone course, students, will develop an independent field-based research project based on a general question in the student's specialty area.	A numerical target will be developed using a grading rubric after the first assessment cycle.	1, 2, 3, 4	A subset of the projects will be randomly selected and independently evaluated by at least 2 faculty members using a standard rubric. This will be done annually and reported at a faculty meeting.
Measure 4-Natural World Assessment. This is a standardized assessment based on scientific and quantitative reasoning that will be administered in ENSC 101 and ENSC 402 (Capstone). This is a direct measure.	A numerical target will be developed using a grading rubric after the first assessment cycle.	3, 4, 5	This will be done annually and an assessment committee will evaluate findings and report at faculty retreat.
Measure 5-Internship and Research Evaluation Forms. This is a standardized evaluation form required of all internships or directed research projects and completed by the appropriate supervisor. This is a direct measure.	A numerical target will be developed using a grading rubric after the first assessment cycle.	5	This will be done annually and an assessment committee will evaluate findings and report at faculty retreat.

IX. Duplication

The table below shows enrollment and completions for the 5 public and 7 private Virginia institutions that offer a BS-level environmental science and/or a BA-level environmental studies degree. The numbers in the table were compiled from data published by SCHEV as E16 report for enrollment and C1.2 report for completion for CIP codes 3.0104 (environmental science) and 3.0103 (environmental studies). We include both degree types here due to the wide range of overlap between these programs at the various institutions. We include George Mason University, University of Mary Washington, and University of Virginia – Wise because they currently have programs in environmental science; however, enrollment data was not yet available.

Enrollments (CIP 3.0104 & 3.0103)	Fall 2007	Fall 2008	Fall 2009	Fall 2010	Fall 2011
University of Virginia (3.0104)	97	123	144	138	154
Virginia Tech (CIP 3.0104)	130	195	146	155	148
Virginia Tech (CIP 3.0103)			84	97	108
George Mason University (3.0104)					
University of Mary Washington (3.0104)					
University of Virginia -Wise (3.0104)					
Totals for Public	227	318	374	390	410
Bridgewater College (3.0104)	21	22	19	30	21
Eastern Mennonite University (CIP 3.0104)	14	13	10		
Eastern Mennonite University (CIP 3.0103)				9	13
Emory and Henry College (CIP 3.0104)	7		10	21	22
Emory and Henry College (CIP 3.0103)		6	5	4	4
Ferrum College (3.0104)	39	41	56	46	58
Lynchburg College (3.0104)	28	37	44	48	49
Randolph College (CIP 3.0104)	2	6	7	2	4
Randolph College (CIP 3.0103)	8	6	3	6	13
Sweet Briar College (CIP 3.0104)	2	6	8	14	10
Sweet Briar College (CIP 3.0103)	11	11	3	3	3
Totals for Private	132	148	165	183	197
TOTALS	359	466	539	573	607
Graduates (CIP 3.0104 & 3.0103)	2006-07	2007-08	2008-09	2009-10	2010-11
University of Virginia (3.0104)	42	39	53	68	61
Virginia Tech (CIP 3.0104)	15	10	29	20	36
Virginia Tech (CIP 3.0103)	14	9	12	23	29
George Mason University (3.0104)					

University of Mary Washington (3.0104)					
University of Virginia -Wise (3.0104)					
Totals for Public	71	58	94	111	126
Bridgewater College (3.0104)	5	6	5	2	7
Eastern Mennonite University (3.0104)	4	2	6	1	
Emory and Henry College (CIP 3.0104)		3	4	2	9
Emory and Henry College (CIP 3.0103)	2	1		1	1
Ferrum College (3.0104)	5	5	3	11	4
Lynchburg College (3.0104)	14	8	9	8	9
Randolph College (CIP 3.0104)			1	4	2
Randolph College (CIP 3.0103)	3	3	4	3	1
Sweet Briar College (CIP 3.0104)	2	2	1		7
Sweet Briar College (CIP 3.0103)	3	4	6	3	
Totals for Private	38	34	39	35	40
TOTALS	109	92	133	146	166

The proposed program in Integrated Environmental Sciences at Longwood University does not unnecessarily duplicate programs at other institutions in Virginia. As indicated in the above enrollment numbers and discussed previously under Student Demand (Section IV), interest by Virginia high school students in environmental science and enrollments in existing programs are both increasing. As Longwood is the only 4-year public institution of higher education in Southside Virginia, this program will serve this economically depressed and under-served region and yield graduates ready to provide much needed expertise in environmental issues in this region and throughout the Commonwealth.

Further, the proposed program in Integrated Environmental Sciences is unique to existing Virginia programs in that it prepares emerging professionals who are well-grounded in the sciences but who are also well-prepared to understand the social context of which they must work and thrive. Throughout this curriculum, the importance of integrating knowledge and skills from the biological, physical, earth, and social sciences will be stressed so that students are well-prepared to help solve current environmental problems within ethical, economic, and cultural frameworks.

X. Student Enrollment Projection

STATE COUNCIL OF HIGHER EDUCATION FOR VIRGINIA SUMMARY OF PROJECTED ENROLLMENTS IN PROPOSED PROGRAM

Year 1		Year 2		Year 3		Year 4 Target Year (2-year institutions)			Year 5 Target Year (4-year institutions)		
2013 - 2014		2014 - 2015		2015 - 2016		2016 - 2017			2017 - 2018		
HDCT	FTES	HDCT	FTES	HDCT	FTES	HDCT	FTES	GRAD	HDCT	FTES	GRAD
20	20	36	35	51	51	67	66		82	82	16

Assumptions:

78% Retention

99% Full-time students

1% Part-time students

Full-time students taking 15 credit hours, graduating in 4 years.

Part-time students taking 7.5 credit hours.

XI. Program Resource Needs

In fiscal year 2012, Longwood University was appropriated \$885,800 from the general fund to support STEM and health-related programs. In fiscal year 2012 these funds were used to support the renovation of existing space for Longwood's Nursing Program. In subsequent fiscal years, beginning in fiscal year 2013, these funds were allocated to other STEM and health-related projects. As part of Longwood's 6-year plan approved by its Board of Visitors on September 10, 2011, a portion of this STEM reallocation has been designated to support a proposed new program in Integrated Environmental Sciences. Outlined in this plan are two full-time faculty positions in the Department of Biological and Environmental Sciences (BES). The first of these two positions is an upgrade of an existing full-time lecturer position in biology to a tenure-track position in biology. As this position will remain in the biology area, this reallocation within the

department will have no effect on the ability of the biology program to offer its course obligations for the major. This position will support the teaching of upper-level courses in biology as well as courses in environmental science.

The second position funded from the STEM reallocation is a new tenure-track position in environmental science. This position will not be hired until fall 2013 (fiscal year 2014). Since the STEM funds designated for this position are available starting in fiscal year 2013, the salary amount for this position will be used during this year before the hire to renovate a new space designated to BES in the Stevens Building. This space will be renovated for the expansion of faculty research in support of the new proposed program. Renovations will be completed prior to the initiation of the new program in fall 2013. This new space will allow for the growth of BES research endeavors of faculty and students as the new program comes online.

Other than the addition of this new faculty research facility, the initiation of this new program will require no additional need for space. Existing classroom space in the Chichester Science Center and across Longwood's campus is sufficient to allow the addition of the new proposed courses and enrollments.

Additionally, \$10,000 of the STEM reallocation has been committed to the program for annual operating expenses. Because these STEM funds have already been allocated and approved in the current 6-year plan, we list them in the tables in Parts B and C below as faculty positions and other costs that are on-going and reallocated. The total funds in Table C noted as ongoing and reallocated (\$180,080) include both the STEM funding (\$119,552) as well as the original salary and fringe benefits amount of the biology lecturer position being converted to tenure-track (\$60,528). The STEM funding also includes \$1000 to refresh the Greenwood Library's environmental science book collection.

There are no new resource needs for this new program.

PROJECTED RESOURCE NEEDS FOR PROPOSED PROGRAM

Part A: Answer the following questions about general budget information.

- Has the institution submitted or will it submit an addendum budget request to cover one-time costs? ☐ Yes ☒ No
- Has the institution submitted or will it submit an addendum budget request to cover operating costs? ☐ Yes ☒ No

- Will there be any operating budget requests for this program that would exceed normal operating budget guidelines (for example, unusual faculty mix, faculty salaries, or resources)? ☐ Yes ☒ No
- Will each type of space for the proposed program be within projected guidelines? ☒ Yes ☐ No
- Will a capital outlay request in support of this program be forthcoming? ☐ Yes ☒ No

DRAFT

Part B: Fill in the number of FTE positions needed for the program

	Program Initiation Year 2013 - 2014		Expected by Target Enrollment Year 2017 - 2018	
	On-going and reallocated	Added (New)	Added (New)**	Total FTE positions
Full-time faculty*	2.00			2.00
Part-time faculty (faculty FTE split with other unit(s))				0.00
Adjunct faculty				0.00
Graduate assistants				0.00
Classified positions				0.00
TOTAL	2.00	0.00	0.00	2.00

* Faculty dedicated to the program

** Added after initiation year

Part C: Estimated resources to initiate and operate the program

	Program Initiation Year 2013 - 2014		Expected by Target Enrollment Year 2017 - 2018	
Full-time faculty	2.00	0.00	0.00	2.00
salaries	\$120,000			\$120,000
fringe benefits	\$49,080			\$49,080
Part-time faculty (faculty FTE split with unit(s))	0.00	0.00	0.00	0.00
salaries				\$0
fringe benefits				\$0
Adjunct faculty	0.00	0.00	0.00	0.00
salaries				\$0
fringe benefits				\$0
Graduate assistants	0.00	0.00	0.00	0.00
salaries				\$0
fringe benefits				\$0
Classified Positions	0.00	0.00	0.00	0.00
salaries				\$0
fringe benefits				\$0

Personnel cost				
salaries	\$120,000	\$0	\$0	\$120,000
fringe benefits	\$49,080	\$0	\$0	\$49,080
Total personnel cost	\$169,080	\$0	\$0	\$169,080
Equipment				\$0
Library	\$1,000			\$1,000
Telecommunication costs				\$0
Other costs (specify)	\$10,000			\$10,000
TOTAL	\$180,080	\$0	\$0	\$180,080

Part D: Certification Statement(s)

The institution will require additional state funding to initiate and sustain this program.

☐ Yes _____
Signature of Chief Academic Officer

☒ No _____
Signature of Chief Academic Officer

If “no,” please complete Items 1, 2, and 3 below.

1. Estimated \$\$ and funding source to initiate and operate the program.

Funding Source	Program initiation year 20 <u>13.00</u> - 20 <u>14.00</u>	Target enrollment year 20 <u>17.00</u> - 20 <u>18.00</u>
Reallocation within the department <i>(Note below the impact this will have within the department.)</i>	\$ 60,528.00	
Reallocation within the school or college <i>(Note below the impact this will have within the school or college.)</i>		
Reallocation within the institution <i>(Note below the impact this will have within the institution.)</i>		
Other funding sources <i>(Specify and note if these are currently available or anticipated.)</i>	\$ 119,552.00	

2. Statement of Impact/Funding Source(s). *If additional space is needed, use the next page.*

There will be no impact within the department. These funds represent a STEM reallocation for the conversion of an existing lecturer position into a tenure-track line. Because the position will remain in the department, there will be no impact on the department. This is described in more detail in the preceding narrative.

3. Secondary Certification.

If resources are reallocated from another unit to support this proposal, the institution will **not** subsequently request additional state funding to restore those resources for their original purpose.

☒ Agree _____
Signature of Chief Academic Officer

☐ Disagree _____
Signature of Chief Academic Officer

XII. Appendices

Appendix A. Letters of support.

DRAFT



CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

February 17, 2012

OFFICERS

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Chair

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VICE CHAIR

JAMES E. ROGERS
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DURAS B. LAPHAM

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CHARLES W. MOORMAN

W. WYLOE MURPHY, JR.

ARNOLD F. RICHMAN

AMAR W. RUDER

ALEXIS D. SANTI

TRUMAN T. SEMANS

ANNE B. SHUMARDINE

JENNIFER STANLEY

BISHOP EUGENE TAYLOR SUTTON

ANTHONY A. WILLIAMS

SUSAN R. WILMORING

PETER L. WOCH

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HONORARY TRUSTEES

D. MATH CAMPBELL

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C.A. PORTER HOPKINS

T. GAYLOR LUTFIELD

H.F. LEWIST

M. LEE MARSTON

WAYNE A. WILKS

RUSSELL C. SCOTT

THOMAS H. STENGER

AILEEN BOWDON TRAPP

Mark Lewis Fink, Ph.D.

Chair, Department of Biological and Environmental Sciences
102B Science Center
Longwood University
201 High Street
Farmville, VA 23909-1801

Re: Integrated Environmental Sciences Major at Longwood University

Dear Dr. Fink:

On behalf of the Chesapeake Bay Foundation, we are writing in support of the proposed Integrated Environmental Sciences major at Longwood University, as it will provide a multidisciplinary perspective of complex environmental issues and better prepare graduates to address pressing problems facing the Chesapeake Bay, its tributaries, and beyond.

This well thought-out and unique program of study would provide strong foundational knowledge in natural and social sciences while emphasizing practical skills and critical thinking. The graduates would be prepared for careers in research, teaching, industry, government, or working with nonprofit agencies like the Chesapeake Bay Foundation.

The time is right for the Commonwealth of Virginia to prepare leaders who can address complex environmental issues through collaborative approaches.

This proposed major would require core competency courses in several critical fields including life sciences, physical sciences, earth sciences, and social sciences. Uniquely, this curriculum includes integrative courses that bring together the core competency knowledge and skills to engage in critical thinking about environmental issues from a multidisciplinary perspective.

It is clear that graduates of this planned major will be prepared to be fully involved citizens of Virginia in stewardship, conservation, and restoration of our natural resources. We fully support this important initiative.

Sincerely,

Ann F. Jennings
Virginia Executive Director

Bill Portlock
Senior Educator for the Bay

CAPITOL PLACE | 1108 EAST MAIN STREET | SUITE 1600 | RICHMOND, VA 23219
804/780-1392 | FAX: 804/648-4011 | CBF.ORG

LAW OFFICE
WILLIAM TAYLOE MURPHY, JR.
A PROFESSIONAL CORPORATION
174 COURT CIRCLE
P.O. BOX 277
WARSAW, VIRGINIA 22572-0277
FAX: (804) 330-3880
(804) 333-4051

February 16, 2012

Dr. Mark Lewis Fink, Ph.D.
Chair, Department of Biological and Environmental Sciences
Associate Professor of Biology
102B Science Center
Longwood University
201 High Street
Farmville, VA 23909-1801

Dear Dr. Fink:

I am very pleased to hear that Longwood University is developing a new major in Integrated Environmental Sciences. Having been deeply engaged in environmental issues in the Commonwealth of Virginia and throughout the Chesapeake Bay Watershed for many years both as a member of the House of Delegates and as Secretary of Natural Resources, I am well aware of the need for educating many more environmentally responsible young people, and the need for more formal programs to provide that education. The future of our quality of life in Virginia and beyond depends on it.

As I read the description of the Integrated Environmental Sciences major, I was particularly impressed with the concept of combining the natural and social sciences to develop individuals better able to understand and address complex environmental issues. I can see where graduates holding this degree will be uniquely qualified to make educated decisions both in regard to hard science and the impact those decisions will have on various populations. Longwood has long been focused on developing citizen leaders and this program reinforces that mission.

I also understand that Hull Springs will play a pivotal role in the development of the new major as the primary field station. Having served on the Hull Springs Farm Foundation Board and the Hull Springs Farm Natural Resources Advisory Council, this pleases me greatly. I also believe that Mary Farley Ames Lee who donated Hull Springs to Longwood, would be delighted with this development.

I wish you the best of luck in the approval process for the new major in Integrated Environmental Sciences and I look forward to its implementation and the impact it can have on the Commonwealth of Virginia.

Sincerely,


W. Tayloe Murphy, Jr.

WTMJr/m



COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

Street address: 629 East Main Street, Richmond, Virginia 23219

Mailing address: P.O. Box 1105, Richmond, Virginia 23218

TDD (804) 698-4021

www.deq.virginia.gov

David K. Paylor
Director

(804) 698-4000
1-800-592-5482

Douglas W. Domenech
Secretary of Natural Resources

March 2, 2012

Mark Lewis Fink, Ph.D.
Chair, Department of Biological and Environmental Sciences
Associate Professor of Biology
102B Science Center
Longwood University
201 High Street
Farmville, VA 23909-1801

Dear Dr. Fink,

This letter is my attempt to show my whole hearted support for the new integrated environmental science curriculum you are proposing at Longwood University.

I am excited about your educational approach to developing citizen leaders with critical thinking skills who will emerge from their studies well equipped to understand and influence complex environmental issues and resource use/allocation decisions. The integration of knowledge from biology, physical, earth and social sciences is a major step forward in bringing these young leaders into the profession well prepared to cope with community based environmental issues.

Citizens of Virginia are living within diverse natural resource rich areas such as the Chesapeake Bay, the coalfields of Southwest Virginia and the Shenandoah Valley. Our Virginia families make their livings from the Bay, the coalmines, the lakes, rivers and streams. Bayside and Seaside communities face many challenges of conflicting resource uses. For example, the agricultural communities aim for more productivity and the fishing communities aim for greater catches. The best practices of each profession often create conflicts within and among communities which are not generally dealt with as we prepare our students in environmental science majors. Other examples include the sincere environmental activists who believe that decisions and outcomes should be made differently who have many opportunities to voice their concerns within the public environmental regulatory and oversight processes here in Virginia. However, in general, even the best educated environmental scientists have never learned about the social aspects and mastered communication skills needed to deal with public dissention and conflict.

This new integrated major would help new young professionals to identify community stakeholders and understand their views and concerns, thus allowing and even encouraging

implementation of true democratic processes within the context of the complicated environmental issues facing Virginia in the future. Wind energy, off shore drilling, oil and gas exploration, uranium mining, land application of biosolids and animal manures, water quality of our lakes, rivers and streams, air quality and ozone issues in more populated and trafficked areas, landfills and odor controls, brownfields cleanup-all involve human actions and interactions with the environment. I urge you to approve this integrated curriculum at Longwood University to help our Virginia students better prepare for the integrated world of applied environmental science in the real world of communities and concerns!

I certainly do believe that a solid environmental science core is required but many students emerge as scientists who are not prepared to deal with the social aspects of the context within which they must work and thrive. This integrated environmental science major at Longwood would create citizen leaders with critical thinking skills in BOTH "hard" and "soft" sciences who could live, work and contribute to equitable solutions to the complex environmental issues facing Virginia. Throughout this proposed curriculum, the importance of integrating knowledge and skills from the biological, physical, earth, and social sciences are stressed in order to solve current environmental problems within ethical, economic, and cultural frameworks.

Again, I truly believe that this integrated curriculum would add a missing component to Virginia's higher education options of study for our university students, and would lead to much better prepared young professional leaders who could then use their strong skills as they replace all the baby boomers who will be soon retiring from environmental groups and agencies throughout the Commonwealth!

Those of us who had to learn many of these things by experience would have appreciated more classes such as those proposed for this curriculum! Please let me know if there is anything I can do to help promote and recruit for this new major when it is approved, as I trust it will be.

Angela M. Neilan (Retired, Virginia Tech, College of Agriculture and Natural Sciences)

Community Involvement Specialist
Virginia Department of Environmental Quality
629 East Main Street, PO Box 1105
Richmond, VA 23218
Angela.Neilan@deq.virginia.gov
804-698-4434

CC: David Paylor, Director, DEQ
Ann Regn, Manager, DEQ Public Affairs, Outreach and Environmental Education



February 22, 2012

Mark Lewis Fink, Ph.D.
Chair, Department of Biological and Environmental Sciences
Associate Professor of Biology
102B Science Center
Longwood University
201 High Street
Farmville, VA 23909-1801

Dear Dr. Fink:

This letter is an eager endorsement and approval for the development of a new major in *Integrated Environmental Sciences* in the Department of Biological and Environmental Sciences at Longwood University. I am an Alumna of Longwood who graduated in 1975 with a B.S. in Biology and a Collegiate Professional Certificate. In 1987 I was awarded by M.S. in Biology and a Postgraduate Professional Certificate from Old Dominion University followed with additional coursework in pursuit of a doctoral program in the Urban Services Program with a Science Education Concentration. My career has included serving as a public school teacher in Virginia for both junior and senior high levels, an education specialist for the Virginia Aquarium, a development specialist for the Virginia Space Grant Consortium, the pollution prevention director for a national, ocean conservation organization (Ocean Conservancy) and now an environmental consultant, managing my own woman-owned company with activities conducted domestically and globally involving federal agencies such as the National Oceanographic and Atmospheric Administration, U.S. Environmental Protection Agency and international organizations including the United Nations Environment Programme and advising the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection that advises the United Nations. I am also serving on the Boards of Clean Virginia Waterways and the Hull Springs Farm Foundation as my ongoing involvement with Longwood's environmental education programming.

While my undergraduate education at Longwood was a good foundation for the 36-year career that I have been able to pursue, I am encouraged to see that your department is actively considering a new major in *Integrated Environmental Sciences*. The scope of environmental issues plaguing the world's terrestrial and aquatic realms has formed a significant gap in collegiate preparation that Longwood is primed to address. Having worked with programs at several universities across Virginia, I know that there is a void in a concentrated program for a broad base of environmental programming that is needed in addressing the variety of environmental and conservation problems impacting our planet. In addition, this new major is also being planned as a part of Longwood's proposed *Center for Excellence in Environmental Education* (CE3) which will benefit greatly from the natural resources of Hull Springs Farm as an educational field station. The combination of the proposed curriculum and the training activities being planned for Longwood's CE3 create a significant foundation for Longwood's students to emerge as well prepared and field-experienced in working with a variety of environmental issues. In addition, these graduates will be competitive in the workforce and in pursuing graduate and post-graduate degrees.

Again, I sincerely endorse and encourage the creation of a new major in *Integrated Environmental Sciences* at Longwood University. Longwood is a very important part of my past and I would be pleased to see its expansion in preparing qualified graduates who could pursue careers in environmental protection and conservation.

Sincerely,

Seba B. Sheavly
President, Sheavly Consultants

Douglas W. Domenech
Secretary of Natural Resources



David A. Johnson
Director

COMMONWEALTH of VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

203 Governor Street
Richmond, Virginia 23219-2010
(804) 786-1712

March 7, 2012

Mark Lewis Fink, Ph.D.
Chair, Department of Biological and Environmental Sciences
102B Science Center
Longwood University
201 High Street
Farmville, VA 23909-1801

Re: Support of an Integrated Sciences Major at Longwood University

Dear Dr. Fink:

The purpose of this letter is to offer this Agency's support of an integrated science major at Longwood University. An integrated environmental science major at Longwood will provide a multidisciplinary perspective to develop citizen leaders who are equipped to understand complex environmental issues. The major would provide strong foundational knowledge in natural and social sciences and emphasize practical skills and integrated critical thinking throughout the curriculum. The Department is excited about students receiving training that is appropriate preparation for graduate studies or careers in research, teaching, industry, government, or nonprofit agencies. The Commonwealth of Virginia needs to train leaders who can address these complex environmental issues through collaborative approaches.

As I understand it, this major would require core competency courses in life sciences, physical sciences, earth sciences, and social sciences with additional coursework emphasizing the development of quantitative and communication skills. The hallmark of this curriculum is the integrative courses that are required throughout each year of coursework, bringing together the core competency knowledge and skills to engage in critical thinking about environmental issues from a multidisciplinary perspective. We appreciate and support this planned major as it is our hope to more fully involve the citizens of Virginia in stewardship activities that conserve and restore the natural resources of the Commonwealth. Thank you for the opportunity to comment and support this important initiative.

Sincerely,

A handwritten signature in dark ink, appearing to read "David A. Johnson".

David A. Johnson

*State Parks • Stormwater Management • Outdoor Recreation Planning
Natural Heritage • Dam Safety and Floodplain Management • Land Conservation*

February 20, 2012

Clean Virginia Waterways

Dr. Mark Lewis Fink, Ph.D.
Chair, Department of Biological and Environmental Sciences
Associate Professor of Biology
Longwood University
201 High Street
Farmville, VA 23909-1801

Longwood University
201 High Street
Farmville, VA 23909

434.395.2602
[fax] 434.395.2978

Dear Dr. Fink:

I am writing to express my strong support for the proposed integrated environmental sciences major at Longwood University. As you know, Clean Virginia Waterways (CVW) has been affiliated with Longwood since 1999, and is housed on the campus. In the 14 years of this win-win partnership, CVW has benefited from the work of dozens of excellent Longwood interns and research assistants.

CVW annually manages several grant-funded programs that have positive impacts on Virginia's water resources. While water is our main focus, we work also on environmental problems related to solid waste, air pollution, land use, and other topics that are connected to water quality. CVW would benefit from having an integrated environmental sciences major on campus, as the program's students could help CVW expand its efforts throughout Virginia. With the proposed major, CVW and the entire Commonwealth of Virginia will benefit as graduates will have a deep understanding of the interconnections of environmental sciences, decision making, and citizen leadership.

Current environment problems present formidable challenges, so expanding environmental education in both the classroom and on campus is critical. Longwood's proposed integrated environmental sciences major is unique and well timed, as it would increase awareness of the scientific, technological, social, cultural, political and economic complexities of our interactions with the environment.

In addition to filling an important need, I believe this major will be popular and vibrant. Over the last six months, I have been keeping track of the many government agencies (federal, state and local), environmental organizations, aquariums, businesses and other organizations that are seeking applicants with knowledge in integrated environmental sciences – I was amazed at the number of job and career openings!

In a consulting role, I have worked extensively with Longwood's Hull Springs Farm in Westmoreland County. Students majoring in this new program will benefit greatly from the educational and research opportunities offered by the diverse natural resources of Hull Springs Farm.

This new major will craft students who are environmentally-aware leaders in our society. Given Longwood's stated desire to be a "greener" campus, such a program would seem a necessity. I unhesitatingly endorse the new major.

Regards,


Kathleen M. Register, Executive Director
Clean Virginia Waterways

CVW is affiliated with Longwood University and Ocean Conservancy

email: cleanva@longwood.edu www.longwood.edu/cleanva



Appendix B. Correspondence indicating student interest in environmental science at Longwood University.

From: Gary T. Pietryk [<mailto:gary.pietryk@live.longwood.edu>]
Sent: Tuesday, February 28, 2012 10:27 AM
To: Morgan, Kathryn
Subject: Env. Studies Major

Mrs. Morgan,

How soon will the environment studies major go into effect? That is my reason for transferring and if LU adopts this major then I won't have to transfer.

Thanks,

Gary

From: Elizabeth M. Watson [<mailto:elizabeth.watson@live.longwood.edu>]
Sent: Wednesday, February 22, 2012 8:06 PM
To: Fink, Alix
Subject: RE: Environmental Science

Dear Dr. Fink,

I am writing to let you know of my decision to transfer out of Longwood University. After spending a year at Longwood, I have decided that I really want to pursue an environmental science major.

Unfortunately, Longwood does not currently offer this major so I will not be able to stay at Longwood.

Please let me know if you would like me to elaborate on this anymore.

Elizabeth Watson

From: Duane Benton [<mailto:dbenton@moonstar.com>]
Sent: Tuesday, September 06, 2011 7:10 PM
To: Fink, Mark
Cc: Buckalew, David; Kristy Benton Grover
Subject: Student name for Environmental Science program at LWU

Dr. Fink, Chair, Science Division: So good talking with you today. My step granddaughter, Bryony Grover, has been sent a package from Longwood Admissions. They were to have included info about a possible Environmental Science major/minor at LWU. Also I have sent her an email with info on fall campus tours and the POC in admissions: Daphne Ratliff 434 -395-2592. Last year when she was a senior in a Fairfax County High School, I sent her books on careers in Environmental Science for Women. Her address is : Bryony Grover, c/o David Grover, 3600 Maryland St., Alexandria, VA 22309-1207. Please keep me informed

on the final approval/start date for this invaluable new addition to the LWU Science Division. When I taught Environmental Law & Regulations in the Science Division Graduate School from 1997-2003, I had several students go on to further graduate study in environmental law and had several students who acquired jobs with the Virginia Dept of Environmental Control. Duane Benton , 434-315-0060.

From: Scott R. Tyree [<mailto:scott.tyree@live.longwood.edu>]

Sent: Friday, September 23, 2011 5:43 PM

To: Fink, Mark

Subject: Environmental Science Major

Dear Dr. Fink,

I had talked to you at the ice cream social about how I am interested in an environmental science major here at Longwood University. I'm just following up that discussion with this email and if there's anything I can do to help out please let me know. Thanks for all of your efforts!

Sincerely
Scott Tyree

High school student comment from our survey of prospective students:

"Longwood was one of my top choices. The major issue that is keeping me from strongly considering Longwood is the lack of an Earth Science or Environmental Science major. I am interested in a program with a strong natural science track (Meteorology, Geology, Hydrology, Climatology, etc). If this was in place, or if I knew for sure it would be in place by my sophomore year, Longwood would be one of the top schools on my list. I am close to making a decision, so please let me know if you can commit to having this program in place."

Sincerely,
Emily Rosenthal
2938 Mother Well Court
Oak Hill, VA 20171

Appendix C. Student surveys and results.

1. Survey of students accepted to Longwood for fall 2012 indicating either a Science or an Undeclared major. This survey was conducted in February 2012. 66 students responded to the survey.

Note: Full results pending.

2. Survey of prospective college students currently attending Virginia high schools. Students surveyed will enter college in fall 2013 and beyond and are currently indicating interest in Science or Undeclared. This survey was conducted in February 2012. 165 students responded to the survey.

Note: Full results pending.

3. Survey of current Longwood students with an Undeclared major. This survey was conducted in February 2012. 39 students responded to the survey.

- 1) If Longwood University offered a major in Environmental Science, I would be interested in majoring in Environmental Science.

Answer Options	Response Percent	Response Count
Strongly disagree	15.4%	6
Disagree	17.9%	7
Neither agree nor disagree	33.3%	13
Agree	12.8%	5
Strongly agree	20.5%	8

- 2) If Longwood University had offered an Environmental Science major before I arrived, I would have been interested in majoring in Environmental Science.

Answer Options	Response Percent	Response Count
Strongly disagree	10.3%	4
Disagree	25.6%	10
Neither agree nor disagree	28.2%	11
Agree	25.6%	10
Strongly agree	10.3%	4

- 3) I would be interested in more information about employment opportunities for Environmental Science majors.

Answer Options	Response Percent	Response Count
Strongly disagree	7.7%	3
Disagree	20.5%	8
Neither agree nor disagree	15.4%	6
Agree	30.8%	12
Strongly agree	25.6%	10

- 4) I am interested in a career involved with studying and finding solutions to current environmental issues.

Answer Options	Response Percent	Response Count
Strongly disagree	5.1%	2
Disagree	17.9%	7
Neither agree nor disagree	35.9%	14
Agree	28.2%	11
Strongly agree	12.8%	5

- 5) I am interested in becoming a forester.

Answer Options	Response Percent	Response Count
Strongly disagree	10.3%	4
Disagree	41.0%	16
Neither agree nor disagree	30.8%	12
Agree	12.8%	5
Strongly agree	5.1%	2

- 6) I am interested in becoming a wildlife or aquatic ecologist.

Answer Options	Response Percent	Response Count
Strongly disagree	10.3%	4
Disagree	30.8%	12
Neither agree nor disagree	20.5%	8
Agree	25.6%	10
Strongly agree	12.8%	5

7) I am interested in becoming a hydrologist.

Answer Options	Response Percent	Response Count
Strongly disagree	12.8%	5
Disagree	43.6%	17
Neither agree nor disagree	25.6%	10
Agree	12.8%	5
Strongly agree	5.1%	2

8) I am interested in becoming a geologist.

Answer Options	Response Percent	Response Count
Strongly disagree	15.4%	6
Disagree	41.0%	16
Neither agree nor disagree	28.2%	11
Agree	12.8%	5
Strongly agree	2.6%	1

9) I am interested in becoming a meteorologist.

Answer Options	Response Percent	Response Count
Strongly disagree	10.3%	4
Disagree	46.2%	18
Neither agree nor disagree	25.6%	10
Agree	10.3%	4
Strongly agree	7.7%	3

10) I am interested in becoming a public policy advocate.

Answer Options	Response Percent	Response Count
Strongly disagree	7.7%	3
Disagree	33.3%	13
Neither agree nor disagree	41.0%	16
Agree	10.3%	4
Strongly agree	7.7%	3

11) I am interested in becoming an environmental engineer/planner.

Answer Options	Response Percent	Response Count
Strongly disagree	10.3%	4
Disagree	35.9%	14
Neither agree nor disagree	23.1%	9
Agree	20.5%	8
Strongly agree	10.3%	4

Appendix D. Employment announcements.

Note: Current job announcements will be added prior to submission to SCHEV.

Appendix E. Sample plan of study.

Full-time student, Life Science Concentration

Semester 1

PHYS 103 – Conceptual Physics – Goal 6 (4)
CHEM 111 – Fundamentals of Chemistry I – Additional B.S. degree requirement (4)
MATH 171 – Statistical Decision Making – Goal 5 (3)
LSEM 100 – Longwood Seminar – Goal 1 (1)
ENGL 150 – Writing and Research – Goal 2 (3)
15 Credit Hours

Semester 2

ENSC 101 – Introduction to Integrated Environmental Sciences (2)
BIOL 122 – Diversity of Life (4)
CHEM 112 – Fundamentals of Chemistry II (4)
COMM 101 – Public Speaking (3)
General Education Goal 3 – Literature (3)
16 Credit hours

Semester 3

EASC 211 – Environmental Geology (4)
MATH 301 – Biostatistics – Additional B.S. degree requirement (3)
SOCL 260 – Environment and Society (3)
General Education Goal 8 – Social Sciences (3)
General Education Goal 4 – Fine Arts (3)
16 Credit Hours

Semester 4

BIOL 341 – General Ecology (4)
GEOG/EASC 275 – Introduction to GIS (4)
ENSC 201 – Integrated Environmental Investigations (4)
EASC 212 – Atmospheric Science (3)
15 Credit Hours

Semester 5

ENSC 340 – Global Environmental Issues (3)
ENSC 380 – Introduction to Environmental Law and Policy (3)
General Education Goal 7 – Western Civilization (3)
General Education Goal 9 – Diversity (3)
Elective for Life Science Concentration – BIOL 342 – Terrestrial Biogeography (4)

16 Credit Hours

Semester 6

ENSC 401 – Environmental Planning and Management (4)

General Education Goal 10 – Foreign Language (3)

General Education Goal 11 – Physical Activity (2)

General Education Goal 12 – PHIL 316 – Environmental Ethics (3)

Elective for Life Science Concentration – BIOL 435 – Advanced Ecology (4)

16 Credit Hours

Semester 7

ENSC 492 or 496 – Internship or Research in Environmental Science – Goal 14 (1)

Elective for Life Science Concentration – BIOL 430 – Conservation Biology (4)

General Elective (3)

General Elective (3)

General Elective (3)

14 Credit Hours

Semester 8

ENSC 402 – Environmental Decision Making (3)

General Education Goal 13 – Active Citizenship (3)

Elective for Life Science Concentration – BIOL 471 – Ornithology (4)

General Elective (3)

13 Credit Hours

Total Credits = 121

Environmental Science Core – 48 credits

General Education – 38 credits

Additional B.S. Degree Requirements – 7 credits

Environmental Science Electives – 16 credits

General Electives – 12 credits

Appendix F. Course descriptions.

New Courses:

ENSC 101. *Introduction to Integrated Environmental Sciences.* This seminar-style course overviews contemporary global issues in environmental science, including species extinction, pollution, resource depletion, and waste. Students examine behavior leading to environmental degradation; consider the scientific, ethical, and economic aspects of the resulting problems; and study policies intended to provide solutions. Students learn to recognize the integration of multiple disciplines in environmental issues and the complexity involved in environmental problem solving. 2 lecture hours. 2 credits.

ENSC 201. *Integrated Environmental Investigations.* This course introduces an interdisciplinary and investigative approach to the science underlying environmental issues and the analysis of environmental problems. Students engage in the process of science through guided inquiry, experiments, and field work, and they will practice design of experiments, analysis and presentation of quantitative data, and written and oral communication. Prerequisites: ENSC 101 and MATH 171. 3 lecture and one 2-hour lab periods. 4 credits.

EASC 211. *Environmental Geology.* This course explores the relationship between humans and their geologic environment, focusing primarily on the processes that act upon the surface of the planet and those relevant to current environmental issues. Students apply geologic principles to the effects of humans on their physical environment. Topics to be covered include: earth materials and structure, geomorphology, plate tectonics, geologic hazards, and resources. 3 lecture hours and 2 lab hours. 4 credits

EASC 212. *Atmospheric Science.* This course examines the processes and patterns of the earth's atmospheric system. Students interpret current weather (meteorology) and long-term trends (climatology) by bridging atmospheric chemistry, physics, and dynamics. Additionally, students analyze human-environment interactions in atmospheric systems, including human impacts on weather and climate and the effect weather and climate have on the environment in which we live. Topics include the Earth-Sun relationship, atmospheric structure and composition, air pollution, wind and global circulation, moisture and precipitation, air masses and fronts, severe weather, climates of the world, and climate change. 3 lecture hours and 2 lab hours. 4 credits.

ENSC/GEOG 340. *Global Environmental Issues.* This course requires students to apply the varied perspectives from the social sciences and natural sciences to gain a more integrated and multifaceted understanding of environmental issues at the global scale. It will examine the effects of globalization on the environment and economy in different parts of the world. Within the context of human population dynamics, the course will examine both physical and social sustainability issues associated with natural resource consumption and environment change. Prerequisite: ENSC 201. 3 credits. WR and SP.

ENSC380. *Introduction to Environmental Law and Policy.* This course provides an introduction to concepts, issues, and statutes in national and international environmental law. In addition to reviewing background constitutional provisions, students examine a representative selection of federal statutes, including the National Environmental Policy Act, the Endangered Species Act, the Clean Water Act, the Clean Air Act, and the Resource Conservation and Recovery Act. The class explores the differences between “Dillon Rule” states (like Virginia) and “Home Rule” states. Students consider the expanding field of multi-nation treaties, laws, and politics governing the global environment as they relate to significant contemporary issues such as global climate change, sustainable development, biodiversity conservation, and transboundary air and water pollution. 3 lecture periods. 3 credits.

ENSC 401. *Environmental Planning and Management.* This course utilizes a comprehensive, interdisciplinary approach to examine issues related to natural resource management and their impacts on the environment. Principles of land use planning are considered within a broad framework that includes topics such as urban and rural development, natural hazard mitigation, ecosystem and watershed management, edaphic and hydrologic features, forest and wildlife management, and marine and coastal planning. The course integrates knowledge from previous coursework to consider the associated social, legal, economic, and scientific aspects, as well as the applications of skills involved in environmental impact assessment, such as GIS and analytical methods. Emphasis is placed on understanding the collaborative nature of approaches, methods, and techniques for sustainability. Prerequisites: GEOG 275, MATH 301, and at least 75 credit hours. 3 lecture and one 2-hour lab periods. 4 credits. WR

ENSC 402. *Environmental Decision Making.* In this interdisciplinary capstone experience, students develop an understanding of and identify potential solutions to current environmental problems. Through a collaborative approach to encourage synthesis and analysis from multiple perspectives, students will develop research, communication (both oral and written), and collaborative work skills. Exploration of

focal problems requires the integration of knowledge and skills from students' work in the natural and social sciences and the consideration of ethical, social justice, and economic perspectives. Furthermore, a civic engagement component provides useful information to the community and provides students with real experience interacting with stakeholders. Prerequisites: GEOG/ENSC 365 and COMM 101. Pre- or Co-requisite: ENSC 401. 3 lecture periods. 3 credits. SP

Existing Courses:

ANTH/SOCL 322. *Sustainability: Prehistoric, Colonial and Contemporary Peoples on the Northern Neck of Virginia.* Students will study the natural and cultural ecology of the Northern Neck focusing on variables such as prehistoric and contemporary climate, soil composition, water, and floral and faunal communities. A key concern running throughout the course will be the cultural patterns utilized by prehistoric, colonial and contemporary human populations in this region. 3 credits.

BIOL 122. *The Diversity of Life.* The second of a two-semester introduction to Longwood-level study of biology for biology and health pre-professional majors. Major topics include eubacteria and archaea; protists; fungi; plant structure, reproduction and development; major animal phyla; animal reproduction and development; and ecological relationships, populations, communities, and ecosystems. Open only to biology majors and minors, environmental sciences minors, and health pre-professional majors. Biology majors must earn at least a C- in this course before taking advanced courses. 3 lecture and one 2-hour lab periods. 4 credits.

BIOL 304. *Microbiology.* A study of the structure, physiology and activities of micro-organisms as related to their role in nature, disease, immunological interactions, industrial processes and human affairs. Basic concepts and fundamental techniques for isolation, growth, identification and immunological reactions are stressed. Prerequisites: BIOL 121 and BIOL 122 with minimum grades of C- or permission of instructor. 3 lecture and two 2-hour lab periods. 5 credits. SP

BIOL 341/EASC 341. *General Ecology.* The principles underlying the interrelations of groups of organisms with their environments, including the population, community and ecosystem levels of organization. The lab normally includes local field trips. Prerequisites: BIOL 121 and BIOL 122 with minimum grades of C- or permission of instructor. 3 lecture and one 3-hour lab periods. 4 credits. WR

BIOL 342/EASC 342/GEOG 342. *Terrestrial Biogeography.* Investigates the past and present geographic distribution of organisms on land. This broad, interdisciplinary course will combine insights from biology, ecology, geography, and geology to examine changes in species distribution over space and time. The course will address topics including: 1) biological patterns across the globe, 2) underlying physical factors controlling these patterns, 3) the role of earth's history in developing these patterns, 4)

and implications for the conservation of plants and animals. 2 lecture periods and 1 two hour lab period. 4 credits.

BIOL 361. *Aquatic Ecology.* A study of streams, ponds, lakes, and wetlands, including their origin, development, morphometry, geochemistry, energy balance, productivity, and the dynamics of plant and animal communities. Major emphasis is placed on learning various field sampling techniques in diverse aquatic settings. Weekend field trips may be required. Prerequisites: CHEM 111, CHEM 112, and BIOL 341 with minimum grades of C- or permission of instructor. 3 lecture and one 5-hour lab periods. 5 credits.

BIOL 430. *Conservation Biology.* A multifaceted course focused on the application of basic ecological principles to complex conservation problems. Successful conservation efforts require that biological solutions be meshed with political, social, and economic realities, and thus conservation biology is an interdisciplinary field. Class discussions and projects will apply basic concepts to the high-stakes field of endangered species management as well as local, regional, and global biodiversity conservation. Students will be required to complete research assignments independently and as a part of a functional team. Prerequisite: BIOL 341 with minimum grade of C- or permission of instructor. 3 lecture and one 2-hour lab periods. 4 credits. SP

BIOL 435. *Advanced Ecology.* Advanced ecological concepts will be emphasized through readings and discussions of primary literature. Various forms of scientific writing will also be taught and practiced through multiple writing assignments. Other miscellaneous topics related to scientific research and career preparation will also be considered. This course is primarily designed for ecology track biology majors who plan to pursue graduate studies. Prerequisite: BIOL 341 or BIOL 441 or permission of instructor. 3 lecture and one 2-hour lab periods. 4 credits. WR and SP

BIOL 443. *Field Botany.* A field course emphasizing the ecology and taxonomy of local plants in their natural habitats. Daily trips are made to local biological communities where specimens are examined and collected to enhance future recognition of the plants. Students are expected to learn the scientific names and classification of the most common bryophytes, pteridophytes, wildflowers, shrubs and trees of the Virginia Piedmont, coast, and mountains. Additional emphasis is placed on the development of skills for using plant keys to determine species identity. Overnight field trips required. Offered during summer session. 6 credits.

BIOL 445. *Tropical Ecology.* A study of evolutionary, ecological, and conservation biology in the New World tropics through intense field work in a Latin American country. Focal areas include identification of typical species of the area, with emphasis on plants, birds, herpetofauna, and mammals; student research projects focused on a question of interest and relevance; and application of key biological concepts in the environmental and cultural context. 4 credits.

BIOL 471. *Ornithology*. A study of the ecology and evolution, form and function and, classification and identification of birds of the world, with an emphasis on Virginia species. Weekend field trips. Prerequisites: BIOL 121 and BIOL 122 with minimum grades of C- or permission of instructor. 3 lectures and one 3-hour lab period. 4 credits.

BIOL 474. *Entomology*. A study of insects: morphology, ecology, evolution, physiology, or taxonomy of the class or of a particular order. Prerequisites: BIOL 121 and 122 with minimum grades of C- or permission of instructor. 3 lecture and one 2-hour lab periods. 4 credits.

CHEM 111. *Fundamentals of Chemistry I*. An introductory course that provides the foundation for further study in chemistry. Major topics include atomic and molecular structure, bonding, stoichiometry, periodic trends, gas laws, and thermochemistry. A grade of at least C- is required in order to continue to CHEM 112. 3 lecture, one 2-hour lab periods. 4 credits.

CHEM 112. *Fundamentals of Chemistry II*. A continuation of CHEM 111 that examines the mechanisms by which chemists obtain information about reacting systems. Major concepts include: chemical equilibrium, thermodynamics, kinetics, gas laws, and electrochemistry. 3 lecture, one 2-hour lab periods. Prerequisite: No grade lower than C- in CHEM 111 or permission of instructor. 4 credits.

CHEM 305. *Organic Chemistry I*. First semester of a two-semester course designed to provide a sound foundation in the fundamental principles and basic reactions of organic chemistry. The course illustrates how three-dimensional structure effects the physical properties and the reactivity of organic compounds. Simple hydrocarbons (alkanes, alkenes, and alkynes) and alkyl halides are used to introduce the concepts of structural isomerism, stereoisomerism, reaction kinetics, thermodynamics, reaction mechanisms, and limited synthetic strategies. Prerequisite: No grade lower than C- in CHEM 112. The course consists of three 1-hour lecture periods per week (3 credits). A one-credit laboratory class (CHEM 307) is also required to complete the organic chemistry requirement.

CHEM 307. *Organic chemistry Laboratory I*. First semester of a two-semester laboratory course designed to provide a sound foundation in the basic methods of performing organic chemical reactions. The course introduces glassware and reaction techniques used in synthetic organic chemistry. The course further illustrates methods used for monitoring chemical reactions, and for isolation and purification of reaction products. Prerequisite: CHEM 112. The course consists of one 3-hour laboratory period per week (1 credit). The course may be taken concurrently with or after CHEM 305.

CHEM 306. *Organic Chemistry II*. Second semester of a two-semester course designed to provide foundation in the fundamental principles and basic reactions of organic chemistry. Increasingly complex compounds like alcohols, amines, substituted aromatic compounds, carboxylic acids, and carboxylic acid derivatives are used to provide heightened emphasis on reaction mechanisms and synthetic strategies.

Structural elucidation techniques (^1H NMR, ^{13}C NMR, IR, and MS) are introduced and are used to identify organic compounds. A one-credit laboratory class (CHEM 308) is also required to complete the organic chemistry requirement. Prerequisite: No grade lower than C- in CHEM 305. 3 lecture periods; 3 credits.

CHEM 308. *Organic Chemistry Laboratory II.* Second semester of a two-semester laboratory course designed to provide a sound foundation in the basic methods of performing organic chemical reactions. The course strongly emphasizes NMR, IR and MS spectral analysis/identification of organic compounds and introduces multistep chemical reactions. Prerequisite: CHEM 307 and concurrently or after 306. The course consists of one 3- hour laboratory period per week (1 credit).

CHEM 350. *Quantitative Analysis.* This course is designed to provide a sound physical understanding of the principles of analytical chemistry and show how these principles are applied in chemistry and related disciplines. Topics covered include statistics, chemical equilibrium, acid-base chemistry, titrimetry, potentiometry, and introduction to analytical separations. The laboratory component of this course focuses on gravimetric and volumetric methods of chemical analysis. 2 lecture, one 4-hour laboratory periods. Prerequisite: CHEM 112. 4 credits.

CHEM 351. *Instrumental Analysis.* The theory of instrumental techniques in analytical chemistry, including optical and electrochemical methods of analysis. Develops familiarity with both instrument physics and the physical chemistry of measurement. Prerequisite: CHEM 350, 3 lecture. 3 credits.

CHEM 372. *Environmental Chemistry.* A study of the fundamental problems of chemistry pollution of the soil, water, and atmosphere. Prerequisite: CHEM 305 or permission of instructor. 2 lecture and one 3-hour laboratory periods; 3 credits.

COMM 101. *Public Speaking.* Introduces students to the basic concepts of human communication, with special emphasis placed on competencies in public speaking. 3 credits. SP

EASC 261. *Meteorology.* A study of the basic weather phenomena and processes including the elements for modern weather forecasting. 3 lecture and one 2-hour lab periods. 4 credits.

EASC 354. *Hydrology.* This course is an introductory survey of hydrology. Emphasis is on the general physical and chemical principles which govern hydrologic processes. Approaches to hydrologic measurements and the application of hydrologic analyses to water-resource management issues will be examined. A basic understanding of elementary mathematics, physics, physical geography, and chemistry is assumed. 3 lecture periods. 3 credits.

EASC 355. *Climatology.* A study of the dynamics of the atmosphere as an energy system, its interactions with other parts of the Earth's physical system, and the effects of these interactions on human life and activity. Climate variations on global, regional, and

local scales are investigated including methods of climate classification and techniques used to model future climatic conditions. 3 lecture periods. 3 credits.

EASC 363. *Physical Oceanography*. An introduction to the historical, geological, chemical and physical aspects of the oceans. 3 lecture and one 2-hour lab periods. 4 credits.

EASC 410. *Geomorphology*. An introduction to the major landform shaping processes that affect the surface of the earth. Human impact on these geomorphic processes, particularly the effects of urbanization and erosive land use, will be discussed with regard to current models of geomorphic change. 3 lecture periods. 3 credits.

ECON 314. *Environmental and Resource Economics*. This course analyzes environmental concerns and the economics of resource use. Specifically, a contrast will be made between governmental solutions to environmental issues and market-based environmental reforms. Issues addressed include: animal extinction and common ownership problems, pollution, water management, global warming/global cooling, and land management. The underlying theme of the course is the ability to use economic theory to develop appropriate incentive structures for the use of economic resources. Prerequisite: ECON 217. 3 credits.

GEOG 241. *Cultural Geography*. A study of the interaction between man and the land. Spatial and time elements are interwoven with selected topics such as man's religions, settlement patterns, political organization, economics, and population characteristics. 3 lecture periods. 3 credits.

GEOG 275. *Introduction to Geographic Information Systems*. Introduces concepts related to geographic information systems (GIS). Topics include cartography, coordinate systems and map projections, data classification and generalization, methods of thematic map symbolization, GIS application domains, data models and sources, analysis methods and output techniques. Lectures, readings and hands-on experience with GIS software. 3 lecture and one 1-hour lab periods. 4 credits.

GEOG 353. *Geography of Virginia*. Geographical appraisal of Virginia, including the geology, landforms, soils, climate, economic minerals, original vegetation, and the human geography of Virginia, emphasizing settlement and population, agriculture, industries and transportation. 3 credits. SP

GEOG 358. *Map Design and Analysis*. Emphasis is focused on the construction of thematic maps at the preprofessional level and their incorporation in presentations of research. Computer-based techniques and processes are stressed along with rudimentary geographic information system design. 3 lecture periods. 4 credits.

GNED 400. *Exploring Public Issues through Writing*. This course engages students in the critical analysis of contemporary issues relevant to democratic citizenship. Students will develop interdisciplinary inquiry and writing as civic skills for active citizenship. 3 credits. Fulfills General Education Goal 14.

HIST 427. *Latin American Environmental History.* This course examines changes in the landscape and in human perceptions of the natural world from the pre-Columbian era to the present in Latin America. Major themes for the pre-Columbian and colonial eras include critical resource management and the relationship between environment and culture. For the national era, emphasis will be placed on the causes of natural capital degradation and efforts to mitigate and eliminate degradation. 3 credits. SP

HLTH 210. *World Health Issues.* An examination of the physical, psychological, social, and environmental dimensions of health as encountered in a variety of cultures with a particular emphasis on those in the non-Western world. 3 credits.*

*General Education Course

HLTH 400. *Environmental Health.* The study of the environment as it relates to the total well being of the individual with special emphasis on the threats to human health posed by the degradation of the environment. Environmental diseases/illnesses attributed to toxic substances, metals, pesticides, food additives and contaminants, radiation, noise, and infectious agents will be addressed. 3 credits.

MATH 171. *Statistical Decision Making.* An elementary statistics course designed to give students a working knowledge of the ideas and tools of practical statistics and their usefulness in problem solving and decision making. Topics include graphical displays of data, measures of central tendency and variability, elementary probability concepts, the normal distribution, correlation and regression, and confidence intervals and hypothesis testing for means and proportions. Special emphasis is placed upon the proper use and interpretation of statistics in real life situations. 3 credits. *Fulfills General Education Goal 5.

MATH 301. *Applied Statistics.* Topics will include one-way and two-way analysis of variance, correlation and linear regression, multiple linear regression, analysis of categorical data (Chi-square tests), and nonparametric tests. Additional topics such as logistic regression and bootstrap methods may also be covered. The emphasis will be on practical applications of these techniques and the use of computer software will be an integral part of the course. Prerequisite: MATH 171 or MATH 270. 3 credits.

RECR 420. *Environmental Education Resources.* This course is designed to explore and provide ways to sensitize human beings to the environment. Emphasis will be placed on examining a variety of ways to interpret the environment in order for people to develop environmental ethics and behaviors. Topics such as history and philosophy, environmental ethics, culture and environmental values and environmental education will be covered. Unique to this class will be the opportunity to apply class information to practical experience in teaching and the development of environmental projects. 3 credits.

SOCL 260. *Environment and Society.* This course provides an introduction to environmental sociology and the sociology of natural resources. Students will investigate the relationship between social and biophysical systems. Key topical areas

include: social definition of the environment and natural resources, theoretical approaches to understanding the relationship between humans and the non-human environment, environmental attitudes, environmental social movements, environmental justice, and the social organization of resource use. Students also will explore how environmental/natural resource assets shape social organization, how social well-being is linked to and affected by natural resource conditions and use patterns, how resource development and use patterns affect social change, and how changing resource conditions affect resource-dependent communities. 3 credits.

Appendix G. Faculty abbreviated CV.

Thomas Akre, Assistant Professor (at LU since 2005), Department of Biological and Environmental Sciences. PhD: George Mason University, 2003, Environmental Science and Public Policy. Research interest: conservation ecology of reptiles and amphibians.

Consuelo Alvarez, Associate Professor (at LU since 2001), Department of Biological and Environmental Sciences. PhD: University of Illinois, 1996, Biochemistry. Research interest: biotechnology techniques for diverse organisms as inter-university collaborations.

Amorette Barber, Assistant Professor (at LU since 2011), Department of Biological and Environmental Sciences. PhD: Dartmouth University, 2009, Microbiology and Immunology. Research interest: tumor immunology.

Dale Beach, Assistant Professor (at LU since 2010), Department of Biological and Environmental Sciences. PhD: University of North Carolina at Chapel Hill, 2002, Cell and Molecular Biology. Research interest: molecular biology of fungal systems.

David Buckalew, Professor (at LU since 1999), Department of Biological and Environmental Sciences. PhD: Colorado State University, 1989, Mycology. Research interest: microbial ecology.

Suzanne Donnelly, Assistant Professor (at LU since 2010), Department of Chemistry and Physics. PhD: University at Albany, 2010. Research interest: representation theory.

Alix Fink, Associate Professor (at LU since 2001), Department of Biological and Environmental Sciences. PhD: University of Missouri, 2003, Fisheries and Wildlife Sciences. Research interest: Effects of landscape change on vertebrate population dynamics.

Mark Fink, Associate Professor (at LU since 2003), Department of Biological and Environmental Sciences. PhD: University of Missouri, 2003, Biological Sciences. Research interests: Avian ecology and conservation biology.

Richard Franssen, Assistant Professor (at LU since 2010), Department of Biological and Environmental Sciences. PhD: University of Chicago, 2007, Organismal Biology and Anatomy. Research interest: origins of natural variation.

Joseph Garcia, Professor (at LU since 1998), Department of Biological and Environmental Sciences. PhD: University of Georgia, 1992, Geography. Research interest: Human impact on river systems.

David Hardin, Associate Professor (at LU since 1991), Department of Biological and Environmental Sciences. PhD: University of Maryland-College Park, Geography. Research interest: Reversal of fortunes for ethnic Serbs in Western Slavonia, Croatia.

Edward L Kinman, Associate Professor and Interim Assistant Dean of the Cook-Cole College of Arts and Sciences (at LU since 2002), Department of Biological and Environmental Sciences. PhD: University of Minnesota, 1996, Geography. Research interests: geography of health, cartography, cultural ecology.

Mary Lehman, Professor (at LU since 1998), Department of Biological and Environmental Sciences. PhD: North Carolina State University, 1998, Botany. Research interest: Plant-animal interactions.

Leigh Lunsford, Assistant Professor (at LU since 2004), Department of Mathematics and Computer Science. PhD: University of Alabama System (Huntsville), 1995. Research interests: Statistics and mathematics education.

Melissa C. Rhoten, Associate Professor (at LU since 2000), Department of Chemistry & Physics, PhD: Virginia Commonwealth University (2000, Analytical Chemistry), Research Interests: Bioelectroanalytical chemistry & chemical education.

Carl Riden, Associate Professor (at LU since 2002), Department of Sociology, Anthropology, and Criminal Justice Studies. PhD: Louisiana State University, 2003, Sociology. Research interest: environmental sociology.

Kelsey Scheitlin, Assistant Professor (at LU since 2010), Department of Biological and Environmental Sciences. PhD: Florida State University, 2010, Geography. Research interest: hurricane climatology.

Brett Szymik, Assistant Professor (at LU since 2009), Department of Biological and Environmental Sciences. PhD: Arizona State University, 2008, Biology. Research interest: Biomechanics and neural control of locomotion in gastropod mollusks.

Walter Witschey, Professor (at LU since 2007), Department of Biological and Environmental Sciences / Sociology, Anthropology, and Criminal Justice Studies. PhD: Tulane University, 1993, Anthropology. Research interest: Maya archeology.

Wade Znosko, Assistant Professor (at LU since 2010), Department of Biological and Environmental Sciences. PhD: University of Pittsburgh, 2010, Biology. Research interest: developmental biology.

Appendix H. Summary of faculty productivity.

Akre, T. A.

Grants

2012 The wood turtle (*Glyptemys insculpta*) in the northeastern United States: a status assessment and conservation strategy.* Director, Dr. Paul Sievert, United States Geological Survey (USGS) and University of Massachusetts (UMass). Co-principal investigators, Dr. Thomas Akre, Longwood University, Dr. Christina Castellano, Orianne Society, Dr. Michael Jones, UMass. Northeast Association of Fish and Wildlife Agencies (NEAFWA) Regional Conservation Needs Grant Program (\$100,000).

2011 Determinants of nest success, hatchling survival, and recruitment for the State Threatened Wood Turtle (*Glyptemys insculpta*).* Principal investigator, T. Akre. Longwood University Faculty Development Grant; for course release (\$6,000).

2011 Determinants of nest success, hatchling survival, and recruitment for the State Threatened Wood Turtle (*Glyptemys insculpta*).* Principal investigator, T. Akre. Blackwell Scholars Faculty Research Grant (\$2,000).

2010-2014 Determinants of nest success, hatchling survival, and recruitment for the State Threatened Wood Turtle (*Glyptemys insculpta*).* Principal investigator, T. Akre. United States Fish and Wildlife Service & Virginia Department of Game and Inland Fisheries State Wildlife Grants (\$135,000).

2010 Determinants of nest success, hatchling survival, and recruitment for the State Threatened Wood Turtle (*Glyptemys insculpta*).* Principal investigator, T. Akre. Longwood University Cook-Cole College of Arts and Sciences Dean's Fund for Scholarship Excellence Grant (\$3,825).

2009 Biotic inventories of selected shorelines of Hull Springs Farm, Westmoreland County, Virginia, to assess productivity of "living shorelines" technologies.* Principal Investigator, Dr. Mark Fink. Assistant Investigators, T. Akre and Dr. Alix Fink. Longwood University Foundation Grant (\$1,000).

2008 Habitat use and activity patterns in resource-rich patches—predatory snakes among known avian nest resources.* Principal investigators, T. Akre, M. Fink, and A. Fink. Longwood University Faculty Development Grant (\$11,850).

2008 Integrating the curricula of mathematics, biological and environmental sciences: a workshop. Principal investigators, Dr. Leah Lunsford, T. Akre, and Dr. Daniel Drukenbrod. Longwood University Cook-Cole College of Arts and Sciences Dean's Fund for Scholarship Excellence Grant (\$3,000).

2007 Biotic inventories of selected shorelines of Hull Springs Farm, Westmoreland County, Virginia, to assess productivity of "living shorelines" technologies.* Principal investigators, M. Fink and T. Akre. Longwood University Foundation Grant (\$6,000).

2006 Vertebrate Ecology Research in Tropical Ecosystems.* Principal investigators, M. Fink, A. Fink, and T. Akre. Longwood University Cook-Cole College of Arts and Sciences Dean's Fund for Scholarship Excellence Grant (\$8,000).

Publications

Iverson, J.B. C.A. Young, T.S. Akre, and C.M. Griffiths. 2012. Female Reproduction in the Bullsnaek (*Pituophis catenifer sayi*) in the Nebraska Sandhills. The Southwestern Naturalist 57:58-73.

Akre, T.S., J.D. Willson, and T.P. Wilson. 2012. Alternative methods for sampling aquatic turtles and squamates. Invited chapter, pp 187-192 *In* McDiarmid, R.W., M.S. Foster, C. Guyer, J.W. Gibbons, and N. Chernoff (Eds.), Reptile Biodiversity, Standard Methods for Inventory and Monitoring. University of California Press. 424 pp.

Rutherford, E.M. and T.S. Akre. 2010. Field Notes: *Pseudotriton ruber* (Red Salamander). Catesbeiana 30:23.*

Lovich. R.E., T. Akre, M. Ryan, S. Nunez, G. Cruz, G. Borjas, N.J. Scott, S. Flores, W. del Cid, A. Flores, C. Rodriguez, I.R. Luque-Montes, and R. Ford. 2010. New herpetofaunal records from southern Honduras. Herpetological Review 41:112-115.*

Buhlmann, K.A., T.S. Akre, J.B. Iverson, D. Karapatakis, R.A. Mittermeier, A. Georges, A. Rhodin, P.P. van Dijk, and J.W. Gibbons. 2009. A global analysis of tortoise and freshwater turtle distributions with identification of priority conservation areas. Chelonian Conservation and Biology 8:116-149.

Bini, L.M. et al. (45 coauthors including T.S. Akre). 2009. Coefficient shifts in geographical ecology: an empirical evaluation of spatial and non-spatial regression. *Ecography* 32:1-12.

Church, D.R., T.S. Akre, and J.C. Mitchell. 2008. Appalachian Amphibians. Invited essay. Pp. 90 *In* Stuart, S.N., M.E. Hoffman, J.S. Chanson, N.A. Cox, R.J. Berridge, P. Ramani, and B.E. Young (Eds.), *Threatened Amphibians of the World*. Lynx Editions. 758 pp.

Peripinan, D., S.M. Hernandez-Divers, K.S. Latimer, T. Akre, C. Hagen, K.A. Buhlmann, and S.J. Hernandez-Divers. 2008. Hematology of the Pascagoula map turtle (*Graptemys gibbonsi*) and the southeast Asian box turtle (*Cuora amboinensis*). *Journal of Zoo and Wildlife Medicine* 39(3):460-463.

Iverson, J.B., C.A. Young, and T.S. Akre. 2008. Body size and growth in the bullsnake (*Pituophis catenifer sayi*) in the Nebraska Sandhills. *Journal of Herpetology* 42(3): 501-507.

Akre, T.S. and K. Fahey. 2008. Spotted Turtle (*Clemmys guttata*). Invited chapter. Pp. 469-471 *In* Jensen, J.B., C.D. Camp, J.W. Gibbons, and M.J. Elliot (Eds.), *Amphibians and Reptiles of Georgia*. University of Georgia Press. 575 pp.

Iverson, J.B., R.M. Brown, T.S. Akre, T. J. Near, M. Le, R.C. Thomson, and D.E. Starkey. 2007. In search of a tree of life for turtles. Pp. 85-106 *In* Shaffer, H.B., N.N. FitzSimmons, A. Georges, and A.G.J. Rhodin (Eds.), *Defining Turtle Diversity: Proceeding of a Workshop on Genetics, Ethics and Taxonomy of Freshwater Turtles and Tortoises*. Chelonian Research Monographs No. 4. 200 pp.

Lovich, R.E. and T.S. Akre. 2007. *Actinemys marmorata* (Pacific pond turtle): Geographic distribution. *Herpetological Review* 38(2):216.

Akre, T.S. and C.H. Ernst. 2006. Population dynamics, home range and habitat use of the wood turtle *Glyptemys* (= *Clemmys*) *insculpta*, in Virginia. Final report to the Virginia Department of Game and Inland Fisheries. 257 pp.

Lovich, R.E., T.S. Akre, M. J. Ryan, N.J. Scott, and R.E. Ford. 2006. *Herpetofaunal survey of Cerro Guanacaure, Montaña La Botija and Isla Del Tigre protected areas in southern Honduras*. Report prepared for the United States Agency for International Development. 33 pp.

Gibbons, J.W., et al. (24 coauthors including T.S. Akre). 2006. Remarkable amphibian biomass and abundance in an isolated wetland: implications for wetland conservation. *Conservation Biology* 20(5):1457-1465.

Presentations

- 2011 The Wildlife Society, Virginia Chapter Annual Meeting, Wakefield, VA
- 2011 Blackwell Scholars Lecture Series, Longwood University, Farmville, VA
- 2010 Virginia Chapter of the Wildlife Society, Harrisonburg, VA
- 2010 Smithsonian Conservation Biology Institute Spring Lecture Series, Front Royal, VA
- 2009 Turtle Survival Alliance, St. Louis, MO
- 2009 Virginia Herpetological Society, Richmond, VA
- 2008 The Society for Conservation Biology, Chattanooga, TN
- 2008 Association of Southeastern Biologists, Greenville, SC
- 2007 Virginia Academy of Sciences, Harrisonburg, VA
- 2006 Society for Conservation Biology, San Jose, CA

Buckalew, D. W.

Grants

- 2011 Microbiological Consultant; Rainwater Harvesting from Commercial Broiler Roofs, Center for Watershed Protection/Rain Management Solutions – National Fish and Wildlife Foundation grant. Award \$90K.
- 2011 Co-Director; Appomattox River Water Quality Monitoring Project (ARWQMP) – VA Department of Environmental Quality (VDEQ) FY 2009, 2010, and 2011 Citizen Monitoring grant. Award: \$4.5K (each yr for 3 yrs)
- 2007 Co-Director; ARWQMP VDEQ FY 2005, 2006, 2007 Citizen monitoring grant. Award : \$5K (each yr for 3 yrs)

Publications

- Buckalew, D.W., G.T. Du, and D.S. Smith. 2012. Effect of sampling depth on counts of *Escherichia coli* in freshwater streams. J. Water Res. (in preparation)
- Buckalew, D.W., L.J. Hartman, G.A. Grimsley, A.E. Martin, and K. M. Register. 2006. A long-term study comparing membrane filtration with Colilert defined substrates in

detecting fecal coliforms and *Escherichia coli* in natural waters. *J. Env. Mgmt.* 80: 191-197.

Presentations

2011 Lucento, S.F., T.M. Smith, and D.W. Buckalew. 2011. Use of indicator bacteria for assessment of water: change of a paradigm? Poster presentation at Annual Meeting, Virginia Branch – American Society for Microbiology (VA-ASM), Virginia Tech, Blacksburg, VA.

2011 Smith, T.M., S.F. Lucento, and D.W. Buckalew. 2011. *Salmonella* spp. numbers much greater than indicator bacteria in environmental waters. Poster presentation at Annual Meeting, VA-ASM, Virginia Tech, Blacksburg, VA.

2010. BIOL 121 Honors students. 12 most common trees and 12 most common fall wildflowers along High Bridge Trail State Park. Poster presentation to area citizens, park rangers and staff.

2009 Jakab, Z., B.K. Rich, and D.W. Buckalew. Effects of a small impaired watershed on bacterial water quality in a storm water pond. Poster presentation at Annual Meeting, VA-ASM, Virginia Commonwealth University.

2009 Betterton, A.A., A.L. Dedor, E.A. Poyner, M.M. Stevens, and D.W. Buckalew. What it takes to be a pathogen: the 7 components of pathogenicity. Posters and flash card samples displayed at 2009 Honors student colloquium, Longwood University.

2008 Beres, K.J. and D.W. Buckalew. Effects of sample preservation technique on counts of coliform bacteria and *E. coli* from environmental water samples. Poster presentation at Annual Meeting, VA-ASM, James Madison University, Harrisonburg, VA

2007 Considine, K.N., A.L. Flowers, and D.W. Buckalew. Bacterial data for the public: creating a web-based map of bacterial assessment sites within an urban watershed. Poster presentation at Annual Meeting, VA-ASM, University of Richmond, Richmond, VA.

2007 A.L. Flowers, K.N. Considine, and D.W. Buckalew. Bacterial stratification within the stream column II: Surface counts. Poster presentation at Annual meeting VA-ASM, University of Richmond, Richmond.

Simmons, A.K., T.W. Lankford, and D.W. Buckalew. 2006. Effect of sampling depth on counts of *Escherichia coli* in freshwater streams. Poster presentation at Annual Meeting VA-ASM, Virginia Military Institute, Lexington, VA Nov 10, 2006.

2006 Tuono, A.J. and D.W. Buckalew. Water sample depth and *Escherichia coli* stratification in freshwater streams. Vera Remsburg Research Scholarship paper

presentation – 84th Annual VA Academy of Sciences Meeting, Virginia Polytechnic and State University, Blacksburg, VA.

2005 Tuono, A.J. and D.W. Buckalew. Effect of sampling depth on counts of *Escherichia coli* in freshwater streams: preliminary results. Poster presentation at VA-ASM Annual Meeting, Virginia Wesleyan College, Norfolk, VA.

2005 Buckalew, DW. How to plan, prepare, and coordinate a water monitoring program. Invited talk. Dept. of Biological Sciences, University of Great Falls, Great Falls, MT.

Fink, M. L.

Grants

2012 Chesapeake Bay Academy: SOLstice (Summer of Learning: Science Teachers Investigating the Chesapeake Environment). Department of Environmental Quality, NOAA, \$11,000.

2011 Chesapeake Bay Academy: SOLstice (Summer of Learning: Science Teachers Investigating the Chesapeake Environment). Department of Environmental Quality, NOAA, \$11,000.

2009 NOAA Grant through Virginia Coastal Zone Management Program in support of living shorelines research at Hull Springs Farm. \$7200.

2009 Biotic inventories of selected shorelines of Hull Springs Farm, Westmoreland County, Virginia, to assess productivity of “living shorelines” technologies.* Principal Investigator, Dr. Mark Fink. Assistant Investigators, T. Akre and Dr. Alix Fink. Longwood University Foundation Grant (\$1,000).

2009 Longwood Faculty Research Grant in support of Hull Springs Farm Living Shorelines Biodiversity project. \$2500.

2008 Longwood Faculty Research Grant in support of early-successional avian ecology research at the Appomattox-Buckingham State Forest. Funding used to provide support for undergraduate research technicians. \$2750.

2008 Habitat use and activity patterns in resource-rich patches—predatory snakes among known avian nest resources.* Principal investigators, T. Akre, M. Fink, and A. Fink. Longwood University Faculty Development Grant (\$11,850).

2008 Margaret Watson Bird Club, research grant in support of undergraduate research, \$700.

2007 Longwood University Foundation Grant in support of research on effects of habitat alteration on community structure and dynamics at Hull Springs Farm, Westmoreland County, Virginia. \$6000.

2006 Dean's Fund for Scholarship Excellence in support of efforts to build capacity and establish research opportunities for undergraduates in the Venezuelan tropics. \$8000.

Publications

Dearborn, D.C., L.S. MacDade, S. Robinson, A.D. Fink, and M.L. Fink. 2009. Offspring development mode and the evolution of brood parasitism. *Behavioral Ecology* 20:517-524.

Fink, M. L. 2009. Preparing future teachers: Using a SENCER approach to positively affect dispositions toward science. *Science Education and Civic Engagement: An International Journal* 2:14-21.

Dalmas, T., M. L. Fink, D. Spears, M. Stinson, and C. Wells. 2006. Birds of Virginia's south-central piedmont: an annotated checklist for Prince Edward and surrounding counties. National Media Service, Inc.

Fink, A. D.

Grants

2011 Chesapeake Bay Academy: SOLstice (Summer of Learning: Science Teachers Investigating the Chesapeake Environment). Department of Environmental Quality, NOAA, \$11,000.

2009 Biotic inventories of selected shorelines of Hull Springs Farm, Westmoreland County, Virginia, to assess productivity of "living shorelines" technologies.* Principal Investigator, Dr. Mark Fink. Assistant Investigators, T. Akre and Dr. Alix Fink. Longwood University Foundation Grant (\$1,000).

2008 Habitat use and activity patterns in resource-rich patches—predatory snakes among known avian nest resources.* Principal investigators, T. Akre, M. Fink, and A. Fink. Longwood University Faculty Development Grant (\$11,850).

Publications

Cole, N. S., and A. D. Dowling Fink. 2010. Complex citizenship: framing an integrative pedagogical approach to prepare 21st century Citizen Leaders. Pages 181-190 in

Stewardship of Public Lands: A Handbook for Educators. American Association of State Colleges and Universities, Washington, D.C.

Dowling Fink, A. D., and N. S. Cole. 2010. Returning wolves and removing mountains: building on the Yellowstone case to create a new approach to civic education. Pages 78-88 in (as above)

Lunsford, M. L., and A. D. Dowling Fink. 2010. Water taste test data. Journal of Statistics Education 18(2).

Dowling Fink, A. D., and M. L. Lunsford. 2009. Bridging the divides: using a collaborative honors research experience to link academic learning to civic issues. Honors in Practice 5: 97-109.

Dearborn, D. C., L. S. MacDade, S. Robinson, A. D. Dowling Fink, and M. L. Fink. 2009. Offspring development mode and the evolution of brood parasitism. Behavioral Ecology 20(3): 517-524.

Fink, A. D., F. R. Thompson, III, and A. A. Tudor. 2006. Songbird use of regenerating forest, glade, and edge habitat types. Journal of Wildlife Management 70(1):180-188.

Woodward, A. A., A. D. Fink, and F. R. Thompson, III. 2001. Edge effects and ecological traps: effects on shrubland birds in Missouri. Journal of Wildlife Management 65(4):668-675.

Fink, A. D., and M. L. Parry. 2007. The Power of Water. The Science Education for New Civic Engagements and Responsibilities (SENCER) 2007 Course Model Series. <http://www.sencer.net/Resources/models.cfm>.

Presentations

2011 The only good wolf: engaging faculty and students in an interdisciplinary approach to natural resource management (poster). The Wildlife Society's Annual Conference, Waikoloa, HI.

2011 Yellowstone as Text: applying Honors pedagogy to contentious civic issues in an interdisciplinary capstone experience. National College Honors Council's Annual Conference, Phoenix, AZ,

2011 Outside the box: engaging students in the learning of science beyond the science requirement. Engaged STEM Learning: From Promising to Pervasive Practices, an AAC&U Network for Academic Renewal Conference, Miami, FL.

2010 Bottom up: using SENCER to foster a community of practice for faculty and civic space for students. National Center for Science and Civic Engagement Washington Symposium, Washington, D.C.

2010 Finding common ground: Yellowstone as the venue for linking science content and civic skills in a capstone experience. National Center for Science and Civic Engagement Washington Symposium, Washington, D.C.

2009 Longwood @ Yellowstone: using Stewardship of Public Lands as an integrative theme for student and faculty engagement. American Democracy Project National Meeting, Baltimore, MD.

2008 Offspring development mode and the evolution of brood parasitism. 12th International Behavioral Ecology Congress. Ithaca, NY.

2008 Effects of habitat and climatic variables on availability of Volant bat prey in Virginia Piedmont forests (poster). Joint meeting of the 8th annual Southern Bat Diversity Network and the 13th annual Colloquium of the Conservation of Mammals in the Southeast United States. Blacksburg, VA.

2008 Bat community structure and foraging activity patterns in a dynamic landscape mosaic in central Virginia. Joint meeting of the 8th annual Southern Bat Diversity Network and the 13th annual Colloquium of the Conservation of Mammals in the Southeast United States. Blacksburg, VA.

2007 Featured model presentation: the Power of Water. SENCER Summer Institute, Portland, ME.

2007 Planning the further assessment of the effectiveness of SENCER (panel plenary presentation). SENCER Summer Institute, Portland, ME.

2007 Bat community dynamics and foraging activity patterns in young regenerating Southern pine plantations (poster). The Wildlife Society's Annual Conference, Tucson, AZ.

2007 Effects of habitat and climatic variables on bat foraging activity and prey availability in Southern pine forests (poster). International Bat Research Conference and North American Symposium on Bat Research, Mérida, Mexico.

2007 Effects of habitat and climatic conditions on availability of volant bat prey in Southern pine forests (poster). Virginia Academy of Science, Harrisonburg, VA.

2006 Bat activity and insect availability in early successional forests: a preliminary analysis (poster). North American Symposium on Bat Research, Wilmington, NC.

2006 Yellowstone's wolves: a model for engaging students in resource stewardship issues. American Democracy Project National Meeting. Snowbird, UT.

2006 Integrative and transformative learning within a mission of Citizen Leadership. Making a Difference in the Lives of Students (ACPA—College Student Educators International—Annual National Convention). Indianapolis, IN. (Collaboration with Student Affairs)

Garcia, J. E.

Grants

2011 Stevenson, C., Bates, B., Barber, M., Garcia, J. (Co-Principal Investigator) A Human Ecodynamics Approach to the Development of Social Complexity in the Piedmont of Virginia and North Carolina (AD 1000-1710), Collaborative Research grant proposal submitted to National Endowment of Humanities, \$291,700 requested, *under review*.

Garcia, J.E. (Principal Investigator) 2005. Investigation of Low-Impact Development Options for Meeting Stormwater Needs, Jan., 2005- February, 2006, Funding source: Commonwealth of Virginia, Department of Conservation and Recreation,. Funding awarded: \$25,000

Publications

Garcia, J.E. 2006. Final Report: RE: BAY-2004-23-SR, Investigation of Low-Impact Development Options for Meeting Storm water Needs, submitted to DCR Division of Soil and Water Conservation

Presentations

2012 Garcia, J.E. and Bates, B. A River Runs Through It? Archaeological and Geological Evidence from 44CH62 – The Randy K. Wade Site, Annual Meeting of the Society for American Archaeology, April 18-22, 2012, Memphis, Tennessee, Presenter

2010 Garcia, J.E., Bates, B and Fletcher, R. An island in the stream? Archaeological and geological evidence from 44CH62 – The Randy Wade Site, Joint Annual Meeting of the Archaeological Society of Virginia and the Eastern States Archaeological Federation Joint Annual Meeting, October 28-31, 2010, Williamsburg, VA. Co-Presenter

Kinman, E. L.

Grants

“Travel Grant.” Virginia Geographic Alliance (\$1,500) to attend and present at Annual Conference of the National Council of Geographic Education in Portland, OR, 2011.

“Travel Grant.” Virginia Geographic Alliance (\$1,500) to attend Annual Conference of the National Council of Geographic Education in Savannah, GA, 2010.

“Geospatial Curriculum Development Initiative Phase II.” Virginia Geographic Alliance (\$23,800) to fund the writing and testing of GIS enhanced lessons for Virginia Studies, World Regional Geography, and Advanced Placement Human Geography. Proposal was funded in December 2009.

“Geospatial Curriculum Development Initiative Phase I.” Virginia Geographic Alliance (\$6,000) to gather GIS spatial data needed to develop GIS enhanced lessons for Virginia Studies, World Regional Geography, and Advanced Placement Human Geography. Proposal was funded in May 2009.

“Beehive.” American Democracy Project at Longwood University (\$2,350), co-investigator, April 2008.

“Now that you know, what must you do? Infusing SENCER ideals and innovative pedagogies through faculty development. National Center for Science and Civic Engagement NSF Sub-Award (\$3,000), co-investigator, October 2007.

Publications

PORTER, E.J., M.S. MARKHAM, E.L. KINMAN, AND L.H. GANONG. EMERGENT SITUATIONS WHEN OLDER HOMEBOUND WOMEN HAD FORTUITOUS HELP AND A TYPOLOGY OF HELPERS WHO WERE INVOLVED. IN J.J.KRONENFELD (ED.), RESEARCH IN THE SOCIOLOGY OF HEALTH CARE. VOL. 29. ACCESS TO CARE AND FACTORS THAT IMPACT ACCESS, PATIENTS AS PARTNERS IN CARE AND CHANGING ROLES OF HEALTH PROVIDERS (PP. 117-148), 2011, OXFORD, ENGLAND: ELSEVIER. DOI: 10.1108/S0275-4959(2011)00000029008

KINMAN E. SCULPTING PLACE THROUGH CERAMICS AND CARTOGRAPHY. IN W. CARTWRIGHT, G. GARTNER, AND A. LEHN, EDS. CARTOGRAPHY AND ART, (PP. 307-316), 2009, BERLIN: SPRINGER PUBLISHING.

KINMAN, E., AND J. WILLIAMS. DOMAIN: COLLABORATING WITH CLAY AND CARTOGRAPHY. CULTURAL GEOGRAPHIES, 2007;14:433-444.

Presentations

2012 “Reflections on the Continual Impact of an Art-Geography Collaboration.” Paper presented with John Williams at Association of American Geographers 107th Annual Meeting, New York City, NY, 27 February 2012.

2012 “Education for Sustainability: A Geo-Literacy Approach.” Paper presented at Many Species, One Planet for Posterity: An International Conference on Science, Society, and Sustainability, Madurai, India, 12 January 2012.

2011 “Exploring Public Issues: A Geo-Literacy Approach.” Paper presented at National Council of Geographic Education Annual Conference, Portland, Oregon, 4 August 2011.

2009 “Creating and Preserving Place in Prince Edward County, Virginia.” Paper given at the 4th Annual Virginia Forum, Farmville, Virginia, 24 April 2009.

2008 “Portraying Place through Ceramics: A Collaborative Experience of a Cartographer and an Artist.” Paper presented at “Art and Cartography – Cartography and Art Symposium sponsored by the International Cartographic Association, Vienna University of Technology, and Academy of Fine Arts Vienna, Vienna, Austria, 2 February 2008.

2007 “Domain: Collaborating with Clay and Cartography.” Poster presented and ceramic tile exhibited at Geography and the Humanities Symposium, Charlottesville, VA, 23 June 2007.

2007 “Map Art: Contesting Space and Preserving Place.” Paper presented at Association of American Geographers 102nd Annual Meeting, San Francisco, CA, 21 April 2007.

2006 “Creating Works of Art with Maps: A Collaborative Exploration by a Geographer and Artist.” Paper presented at Association of American Geographers 102nd Annual Meeting, Chicago, IL, 9 March 2006.

Lehman, M. E.

Presentations

2011. Effects of Phenolic Acids on Ovipositional Selection in the Cabbage White Butterfly, *Pieris rapae*. Poster presentation at the Annual Meeting of the Virginia Academy of Science.

2011 Effects of Host Plant Allelochemical and Nutrient Status on the Cabbage White Butterfly, *Pieris rapae*. Poster presentation at the Annual Meeting of the Virginia Academy of Science.

2009 Relationships of Learning Styles, Grades, and Educational Preferences. NACTA annual meeting (North American Colleges and Teachers of Agriculture and Life Sciences).

2007 Interactions of Allelopathy and Heat Stress in Plants. Virginia Academy of Science annual meeting. Harrisonburg, Virginia.

Scheitlin, K. N.

Grants

2012 Lust, P. A. Fink, M. Fink, S. Donnelly, M. Rhoten, K. Scheitlin, L. Shilling, and K. Register. Chesapeake Bay Academy: SOLstice Science Teacher's Experience. Department of Environmental Quality, NOAA, \$11,000.

2011 Great Investigations: Development of a Great Plains field course. University Committee on Faculty Development, Longwood University, \$1425.

2011 Lust, P. M. Fink, S. Donnelly, M. Rhoten, K. Scheitlin, L. Lunsford, N. Langlie, and K. Register. Chesapeake Bay Academy: SOLstice Science Teacher's Experience. Department of Environmental Quality, NOAA, \$11,000.

2009 Construction and application of a spatial hurricane climatology. The Graduate School at Florida State University, \$700.

Publications

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