New Degree Program Proposal

Professional Science Masters

College of Liberal Arts and Sciences
Environmental Studies Program
The University of Kansas

November 2012
**Basic Program Information**

Proposing institution: The University of Kansas

Title of proposed program: Professional Science Masters

Degree(s) to be offered: Professional Science Masters, with a Concentration in Environmental Assessment (PSM-EA)

Anticipated date of implementation: Fall 2013

Responsible department(s) or unit(s): College of Liberal Arts and Sciences, University of Kansas

Point of Contact: J. Christopher Brown, Director Environmental Studies Program

(CIP) code associated with the program: 03.0103
Program Proposal Narrative

(a) Program Need and Student Characteristics

The Professional Science Masters professional graduate degree is designed for graduates of bachelor’s programs in physical/natural sciences, environmental studies, civil/environmental engineering or related fields who are currently employed in private firms, public agencies, and not-for-profit organizations that address a range of environmental issues. Key foci in the science curriculum of this program are environmental impact assessment; soils, water, and ecosystems science; geospatial analysis; environmental health and policy; and an understanding of environmental law and policy and the regulatory environment.

The Professional Science Master’s (PSM) is a relatively new interdisciplinary graduate degree that combines advanced coursework in science with a set of professional skills courses (project management, technical writing/communications, financial management), and a capstone/internship experience (see Appendix A for full PSM framework). Most PSM degree programs establish an External Advisory Board from professionals working in the subject area to assist with clarifying program objectives, identifying expected learning and professional development outcomes, and ensuring that regional workforce needs are met.

The CLAS PSM will be launched with a concentration in Environmental Assessment based in the CLAS Environmental Studies Program. Broadly stated, environmental assessment identifies possible environmental effects of a project or program, proposes measures to mitigate adverse effects, and predicts whether there will be significant adverse environmental effects, even after the mitigation is implemented. By its nature, environmental assessment is highly interdisciplinary, drawing on, for example, training in biology, geology, chemistry, hydrology, and geospatial analysis, as well as requiring project management and professional communications skills.

The Council of Graduate Studies reports that the bulk of new jobs being created are in the non-academic sector, and master’s graduates are more likely to be employed in the state in which they earned a degree compared to Ph.D. graduates. Furthermore, PSM graduates contribute to workforce development through their ability to manage and grow science & technology based industries.

(1) Is the program central to the mission of the institution?

The proposed program shall be centrally related to the Board approved Mission Statement of the institution.

The Lawrence Campus Mission Statement: The university is committed to offering the highest quality undergraduate, professional and graduate programs, comparable to the best obtainable anywhere in the nation. As the AAU research University of the State, the University of Kansas offers a broad array of advanced graduate study programs and fulfills its mission through faculty, academic and research programs of international distinction and outstanding libraries, teaching museums and information technology. These resources enrich the undergraduate experience and are essential for graduate-level education and for research.
The KU Edwards Mission Statement: The mission of the Edwards Campus is to bring the high-quality academic programs, research and public service of the University of Kansas to the greater Kansas City community to serve the workforce, economic and community development needs of the region.

The proposed PSM supports the mission of The University of Kansas by offering a high quality graduate program in applied science, with a concentration focused on environmental problems and issues faced by government and industry. The content of courses and the overall curriculum is based on the best practices as defined by the National Professional Science Master's Association (NPSMA). The proposed PSM will support the mission of the KU Edwards Campus by providing a degree program, concentrations, and courses to the greater Kansas City community at a time and place to meet the needs of the workforce, economy, and community development needs of the region.

(2) What is the student demand for the program?

The volume of student demand for the proposed program shall be demonstrated through some form of disciplined survey analysis.

A query of a database created by the Environmental Studies Program of over 1200 KU undergraduates who graduated with a major in Environmental Studies indicates that over 500 of these graduates still reside in the greater Kansas City metropolitan area. Over 20% of these graduates reside within a few miles of the KU Edwards campus, in Olathe, Overland Park, and Lenexa. Only 22% of the 1200+ graduates in the database reported completing an advanced graduate degree in any field.

To obtain additional information on the pool of KU undergraduates with bachelor’s degrees in the natural sciences or environmental studies who would potentially enroll in the PSM-EA, the KU Academic Information Management System was queried for the total numbers of bachelor’s degrees awarded by KU since 2002 in biology, environmental studies, geography, and geology. These results are presented in the table below.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>221</td>
<td>229</td>
<td>248</td>
<td>235</td>
<td>219</td>
<td>201</td>
<td>194</td>
<td>227</td>
<td>224</td>
</tr>
<tr>
<td>Env. Studies</td>
<td>26</td>
<td>29</td>
<td>23</td>
<td>25</td>
<td>35</td>
<td>43</td>
<td>41</td>
<td>58</td>
<td>51</td>
</tr>
<tr>
<td>Geography</td>
<td>40</td>
<td>37</td>
<td>32</td>
<td>37</td>
<td>41</td>
<td>37</td>
<td>47</td>
<td>49</td>
<td>51</td>
</tr>
<tr>
<td>Geology</td>
<td>16</td>
<td>12</td>
<td>17</td>
<td>9</td>
<td>16</td>
<td>9</td>
<td>13</td>
<td>22</td>
<td>15</td>
</tr>
<tr>
<td>Total/year</td>
<td>303</td>
<td>307</td>
<td>320</td>
<td>306</td>
<td>311</td>
<td>290</td>
<td>295</td>
<td>356</td>
<td>341</td>
</tr>
</tbody>
</table>

From October through mid-December 2007, a three-part study was conducted by DeSieghardt Strategic Communications of Stilwell, Kansas, on behalf of the KU Edwards Campus. The study sought to determine what – if any – educational programming expansion should be considered by the Edwards Campus by studying the current and future human resource needs among Kansas City’s leading employers and matching that with a comprehensive evaluation of interest in targeted potential degree
programs. Extrapolations from a telephone survey conducted in 2007 in Johnson County by DeSieghardt projected that 10% of Johnson County residents who are ages 25 to 45 and who responded that they are “very” or “somewhat” likely to go to/return to school within the next three to five years were interested in obtaining a masters degree specifically in the bioscience and applied science fields.

(3) **What is the demand for graduates of this program?**

An in-depth review of the Kansas City Metropolitan area job market showed 94 current openings and expected increases in demand ranging from 6% to 17% between now and 2022 for the following jobs: Environmental Science and Protection Technicians, Including Health (SOC 19-4091), Environmental Scientists and Specialists, Including Health (SOC 19-2041), Geoscientists (SOC 19-2042), and Natural Science Managers (SOC 11-9121). (See Appendix B for complete details)

Patron Insight, Inc. conducted a qualitative study in 2007 and a follow up study in 2010 to determine the needs of employers, career opportunities, identify specific skill sets valued by employers and determine the steps to be taken by the KU Edwards Campus to continue its ties with the business and civic community. The participants in the study consisted of 18 industry leaders, who were interviewed and asked to respond to a standard set of questions. The 2010 report summary stated; “Today’s career opportunities necessitate more evolved complementary skills, beyond the technical expectations of the jobs themselves. Today, managers and administrators must be able to see a project through from inception to completion (recognizing that he or she will not be in all steps of the process), blending technical prowess with polished communication skills, and with the ability to work in a team setting with team members who may be merely voices on a telephone, images beamed on a videoconference and words on an e-mail message.”

Data from the Bureau of Labor Statistics indicates that an estimated 550 professionals are employed in the Greater Kansas City Metropolitan Area as “Environmental Scientists and Specialists”, with a mean annual income of $62,280. By including additional occupational titles that fall under the broader description of environmentally-related professions (hydrologists, soil scientists, environmental science and protection technicians, etc) that increases to over 4000 environmental professionals with a mean salary of $55,600.(See Appendix C for full details)

The Bureau of Labor Statistics noted in its national Job Outlook for Environmental Scientists:

“Employment of environmental scientists and specialists is expected to increase by 28 percent between 2008 and 2018, much faster than the average for all occupations. Job growth should be strongest in private-sector consulting firms. Growth in employment will be spurred largely by the increasing demands placed on the environment by population growth and increasing awareness of the problems caused by environmental degradation. Much job growth will result from a continued need to monitor the quality of the environment, to interpret the impact of human actions on terrestrial and aquatic ecosystems, and to develop strategies for restoring ecosystems.”

**The proposal shall also demonstrate other post-collegiate experiences for graduates of this program.**

For the majority of the students in the PSM Program, this degree will be their terminal degree.
(4) **What are the locational and comparative advantages of this program?**

The Professional Science Masters with a concentration in Environmental Assessment is completely new to the Kansas Regents System. The greater Kansas City metropolitan area is home to several regional federal environmental agencies including the US Army Corps of Engineers (Kansas City District) and the US Environmental Protection Agency (Region 7), numerous large and small private environmental/engineering companies (e.g., Black and Veatch, Bartlett and West, Wilson and Company, URS Engineering, AquaTerra Environmental Services, Terracon Engineering, Burns and McDonnell, Ecology and Environment Inc., and Marshall Miller & Associates), state and local environmental agencies (Johnson County Environmental Department, Kansas Department of Health and Environment, Kansas Department of Wildlife, Parks, and Tourism), and nongovernmental organizations (e.g., MidAmerica Regional Council). This concentration of environmental agencies/companies offers several strong advantages for the proposed PSM-EA program: first, a large latent pool of students for the program; second, numerous opportunities in these companies and agencies for internships for our PSM-EA students; and third, a pool of environmental professionals to draw upon for lecturers/professors-of-practice for our courses and for our External Advisory Board.

*The proposal shall discuss and compare similar programs in the region and compare their quality with the program under consideration.*

No PSM with an Environmental Assessment concentration is offered through public institutions of higher education in Kansas. The only existing PSM in the state is offered by Fort Hays State University. The FHSU PSM focuses exclusively on the biological sciences, emphasizing course work in botany, wildlife management, etc, as opposed to the more interdisciplinary environmental science/environmental assessment focus of the PSM-EA program. Regionally, several universities have similar environmentally-oriented PSMs: Missouri State University at Springfield, MO (PSM in Natural and Applied Science); University of North Texas (PSM in Environmental Science); University of Northern Iowa (PSM in Ecosystem Management); and Southern Illinois University at Edwardsville (PSM in Environmental Science Management).

*The proposal shall demonstrate why the program should be located at the proposing institution.*

The principal target student population for the PSM-EA degree is working professionals who have received their undergraduate degree and are pursuing career advancement. The Kansas City metropolitan area is a hub of environmentally related business that provide potential student population for this program and places of internship for program completion. To allow students to work in the Kansas City area while furthering their careers, the courses will be exclusively offered in the evenings at the KU Edwards Campus in Overland Park, KS. This location is within easy driving distance from most Kansas City metro locations.

*The proposal shall consider and demonstrate the advantages and disadvantages of a program being a freestanding, cooperative or joint program including collaborative degree options.*

The PSM-EA will utilize existing graduate science courses already offered at the KU-Edwards campus, and will add additional graduate science courses taught at Edwards or jointly with the KU-Lawrence campus. Furthermore, the PSM-EA will share a common core/professional skills curriculum with other
PSM programs at KU-Edwards Including the proposed PSM in Project Management and future PSM proposals.

The proposal shall state where the institution ranks the proposed program in its list of priorities. The proposal shall state how this determination has been made.

This proposed program is being funded by Johnson County Education Research Triangle sales tax. The Johnson County Kansas Education Research Triangle (JCERT) was created in November 2008 when residents invested in the county's future by voting for a one-eighth cent sales tax. The proceeds from this tax, first assessed in April 2009, generate more than $15 million a year to fund higher education and degree offerings through a unique partnership among Johnson County, the University of Kansas and Kansas State University. The initiative includes the development of the Business, Engineering, Science and Technology (BEST) Building and new degree programs at KU's Edwards Campus in Overland Park; the International Animal Health and Food Safety Institute at K-State's Innovation Campus in Olathe; and The University of Kansas Clinical Research Center at Fairway.

These new facilities will help create economic stimulus and a higher quality of life by enhancing the economic future of Johnson County, the state of Kansas and the Midwest. The economic impact over the next two decades is expected to be well over $1.4 billion and attract millions of dollars in private and public donations and research grants.

The JCERT partnership and passage of the sales tax funded the construction of a 75,000-square-foot, $25 million building on the KU Edwards Campus. The new Business, Engineering, Science and Technology (BEST) Building houses classrooms, a business conference center and faculty offices. It will allow enrollment at the KU Edwards Campus to grow by 1,000 students. Construction of the new building began in summer 2010 and was completed January 2012. Through this expansion, the Edwards Campus will strengthen its impact on the community with 10 new degree programs in the BEST arena.

The proposal shall state the importance of establishing this particular program vis-a-vis other program alternatives.

The University of Kansas Edwards Campus is committed to offering six or more graduate degree programs as part of the Johnson County Education and Research Triangle (JCERT) initiative. These programs must demonstrate that they fill some workforce demand/need and this proposal has met that qualification.

(5) What are the characteristics of the students who will participate in this proposed program?

The principal student cohort targeted by this program will be the professional working adult, interested in career advancement and advanced education. The typical student will be between the ages of 25 - 45 years. Because of work and family obligations, this type of student will enroll typically in one evening course per semester. We are also targeting two other minor cohorts of students: first, students who have just completed their undergraduate degrees in the sciences who are looking toward careers in private companies and public agencies and who wish to obtain a professional degree rather than a
research degree; and second, current or retired military personnel who wish a professional science degree for career advancement and advanced education.

The specific procedures and criteria for admission into this proposed program shall be described.

The admissions requirements for the Professional Science Masters with a concentration in Environmental Assessment are as follows:

1. A 3.0 or higher grade point average (on a 4.0 scale);
2. GRE score of 500 on the verbal and quantitative sections.
3. Bachelor’s degree from an accredited institution;
4. Submission of a letter of interest and at least two letters of recommendation;
5. The student must have an undergraduate background of at least 20 semester hours in the natural and applied sciences.
6. International students must also meet the English proficiency, visa/I20, and financial support requirements.

The specific opportunities for student interaction shall be described.

The opportunities for student-to-student and student-to-instructor interaction will include; typical classroom discussion, class project team interaction, communication and discussion via Blackboard. The capstone project in the curriculum provides a unique opportunity for student competencies to be appraised by both industry leaders and the faculty. Students in other KU PSM programs such as the biosciences and engineering management PSMs will expand the network capability of these students. All PSM students will be taking the same core/professional skills courses as a cohort affording them the opportunity to interact.
(b) What is the curriculum of the proposed program?

Describe the more important academic objectives of the proposed program, including the range of skills and knowledge future graduates will possess.

Environmental Assessment:
Graduates of the PSM-EA will have an in-depth understanding of:

- Environmental law and regulations, including National Environmental Policy Act, Endangered Species Act, Migratory Bird Treaty Act, National Historic Preservation Act, Bald and Golden Eagle Protection Act, Clean Water Act, Clean Air Act, CERCLA, RCRA, and Superfund;
- Environmental politics and the formulation and implementation of environmental policy, including the history and development of environmental politics as well as current trends and themes, including interest groups, business interests, political institutions, and specific environmental policy issues;
- The National Environmental Policy Act specifically, its implementation, requirements, and implications for environmental work by companies and agencies;
- The need for environmental impact assessments, the difference between environmental assessments versus environmental impact assessments, and the regulatory and technical requirements of preparing an assessment;
- Assess the environmental, societal, and economic impacts of projects and programs;
- Relating the uses of scientific research to practical situations in project planning and decisionmaking.

Core/Professional Skills:
Graduates of the PSM-EA will have an understanding of:

- Basic concepts in business skills: practical accounting and finance, marketing, project management, and entrepreneurship;
- Communications skills: possess effective scientific writing and oral presentation capabilities in a professional environment, whether scientific or non-scientific;
- Ethical issues in scientific and social settings; and
- How to apply scientific knowledge in a variety of settings and by working as part of a multidisciplinary team.

The course work required of all students who major in this program shall be described. Attachment I, the curricular outline form, shall be completed (see attached Attachment I).

Internships and practica required of students in this program shall be described.

An integral part of every PSM degree, regardless of field, is the Capstone, defined as a culminating experiential component to develop a workforce project, producing a written report and presented orally. The capstone project is developed and supervised collaboratively by faculty and employers, and evaluated or graded by faculty with input from the employer. For a student who is not already employed, a semester-long internship with a private firm or public agency is established. The intent of the Capstone is to integrate the practical application of scientific and professional knowledge, behavior, and skills.
(c) Program Faculty.

(1) What is the quality of the faculty?

*The instructional staff shall consist of faculty whose academic, instructional and scholarly accomplishments suggest that the proposed program will be of high quality and appropriate to the institution’s mission, role and aspirations.*

This is a new program and there are currently no faculty specifically dedicated to this degree program. For much of its curriculum, the PSM-EA will draw predominantly on existing graduate courses taught by KU faculty affiliated with the KU Environmental Studies Program and offered jointly by KU-Lawrence and KU-Edwards. Several new hires may fall under the Professor of Practice classification. “Professors of the Practice” are non-tenure track faculty who possess the expertise and achievements to provide professional instruction in a manner that brings distinction to the appointing School/College and the University. Research responsibilities are not included in the expectations for professors of the practice. Professors of the practice should have professional teaching and service responsibilities that are significantly heavier than those of tenured and tenure-track faculty. A Professor of the Practice should hold the professional degree and licensing/certification in the field, with the additional requirements of significant experience and a distinguished record of achievement in her or his field.

*The number, qualifications and rank of proposed new faculty shall be identified.*

For those courses not presently offered by existing faculty, 0.5 FTE Adjuncts, Lecturers, or Professors of Practice will be hired in Year 1, increasing by 0.25 FTE to 1.0 FTE by Year 3. A PSM-EA director or coordinator will be hired in Year 1, drawn from faculty or faculty-equivalent staff (PhD-level). This person will manage the program, provide advising to potential and current students, work with the external advisory board, and develop and implement a student recruitment plan. Additionally, the PSM-EA director will teach EVRN 590, the PSM-EA Capstone, every semester with the exception of Year 1.

*The cost of proposed new faculty shall be identified, along with expected timelines for their employment by the institution.*

Year 1: 0.5 FTE Adjuncts, Lecturers, or Professors of Practice = $30K  
PSM-EA Director (.50 FTE): $50K

Year 2: 0.75 FTE Adjuncts, Lecturers, or Professors of Practice = $45K  
Program Assistant (0.50 FTE): $18K  
PSM-EA Director (.50 FTE): $50K

Year 3: 1.0 FTE Adjuncts, Lecturers, or Professors of Practice = $60K  
Program Assistant (0.50 FTE): $20K  
PSM-EA Director (.50 FTE): $50K

---

1 KU Policy on Professor of the Practice. https://documents.ku.edu/policies/provost/ProfessorofPractice.htm
The proposal shall include curriculum vitae of all faculty delivering courses for the proposed major

See Appendix D.

Because this program is new and many of the courses will be taught by faculty and academic staff yet to be identified or hired, we have included only the CVs of Dr. J. Christopher Brown, Director of the Environmental Studies Program, and Dr. Mark Jakubauskas, proposed director of the PSM in Environmental Assessment.

(2) How many graduate assistants will serve the program?

There will be no Graduate Teaching Assistants or Graduate Research Assistants in this program.
(d) **Academic Support.**

**1. What are the academic support services, advising services, library, audio-visual and academic computing services for this program?**

Full academic support services are offered through the KU Edwards campus. KU Edwards provides numerous student services, including the Regents Center Library, the Writing Center, and the KU Bookstore at Edwards. Five computer labs are located at KU Edwards in the Regents Center and Regnier Hall, and four new labs in the newly constructed BEST Building at Edwards that provide space for 30, 60 or 90 student stations. Software provided by the Edwards Campus IT on all computers includes Internet Explorer, Mozilla Firefox; Microsoft Office 2007; SPSS 17; Adobe Acrobat Reader, Flash Player, Shockwave, Quick Time, Real Player, Endnote, Sophos Antivirus, Roxio CD Creator, and PowerDVD. The space provided by the new BEST building will be utilized for PSM classes and offices.

The proposed PSM-EA program will purchase a site license for the ArcGIS geographic information systems software to be installed in an existing computer lab at the KU-Edwards campus for classroom and student project use at an annual cost of $3500. This license will be part of the larger KU ArcGIS license currently administered by the Kansas Biological Survey for KU.

**2. What new library materials and other forms of academic support are required beyond normal additions?**

The expectation for new resources will be not be beyond the normal requirements.

**3. What new supporting staff will be required beyond normal additions?**

The program will benefit from a 0.50 FTE Program Assistant, starting in Year 2 and continuing who will assist the PSM-EA Coordinator in student recruitment, admissions, advising, management of the PSM-EA External Advisory Board, external development, and evaluation/tracking of PSM-EA alumni.

(e) **Facilities and Equipment.**

**1. What are the anticipated facilities requirements (existing, renovated or new)?**

All facilities, equipment and space are already available as provided by the Johnson County Education Research Triangle, via the BEST building expansion. Office space for the PSM-EA director and program assistant will be required as well as office computers for each. IT support and telecommunications will be provided by KU-Edwards.

**2. What new equipment will be required beyond normal additions?**

No additional new equipment additions are anticipated.
(f) Program Review, Assessment and Accreditation.

(1) What program review process or evaluation methods will be used to review the program?
(2) What student learning outcomes measures will be used to assess the program's effectiveness?
(3) What are the institution's plans regarding program accreditation?

- The program shall identify the specialized accrediting agency where applicable.
- The proposal shall identify institutional plans to have the program accredited, including timelines and projected costs of achieving and maintaining accreditation.

In addition to regular mandated University review, the program will have an External Advisory Board (EAB) to provide review and oversight. As part of the PSM-EA proposal development, fourteen environmental professionals were identified and invited to serve on a PSM-EA External Advisory Board (See Appendix E for EAB member list). They come from environmental professionals at private firms, public agencies, and nonprofits in the Greater Kansas City metro area. This EAB met in July 2012 at the KU-Edwards Campus with KU faculty and staff developing the PSM-EA to provide input on the proposed curriculum, internship opportunities for possible PSM-EA students, and employment outlook and opportunities for PSM-EA graduates. As the PSM program develops and students progress through the degree, the EAB will continue to provide input and review of the curriculum to maintain relevance, to identify and facilitate internship and capstone project opportunities, and to publicize the program and identify potential students who could benefit from the PSM. The EAB will meet formally at the Edwards Campus at least annually, and informal contact and input from the EAB will be maintained by the PSM-EA director.

The PSM-EA program will also affiliate with the PSM Initiative of the Council of Graduate Schools, which has established guidelines for recognition of professional science masters programs:

1. The institution must be accredited by a regional accrediting association;
2. A program must have stated goals and learning outcomes appropriate to the particular degree;
3. The total number of credits must be at least equivalent to the minimum number for a master’s degree at the institution;
4. Programs must have the following components:
   - A majority of course content in the natural sciences, engineering, mathematics, and or computational sciences;
   - A professional skills component;
   - An experiential component that includes at least one capstone project.
5. Program quality assurance must be provided using the faculty-based mechanisms usually used by the institution for graduate programs in order to make sure the program is fully integrated into the academic offerings of the institutions and is sustainable over time;
6. An active and engaged advisory board from industry, business, government and/or non-profit organizations is required;
7. The program must collect annual data relative to enrollment, degrees, completion, and demographics; and the employment history of the graduate should be tracked to help assess program outcomes.

---

I. Identify the new degree:

Professional Science Masters (Concentration in Environmental Assessment)

II. Provide courses required for each student in the major:

<table>
<thead>
<tr>
<th>Course Name &amp; Number</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Core Courses</strong></td>
<td></td>
</tr>
<tr>
<td>PMGT 816: Project Management Fundamentals</td>
<td>3.0</td>
</tr>
<tr>
<td>ENTR 701: Entrepreneurship - Starting Your Own Business</td>
<td>3.0</td>
</tr>
<tr>
<td>ACCT 7xx: Survey of Accounting (3)</td>
<td>3.0</td>
</tr>
</tbody>
</table>

(This course will be developed to the specific needs of the P.S.M. degrees and will be assigned a number once developed)

<table>
<thead>
<tr>
<th>Course Name &amp; Number</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMS 730: Writing &amp; Speaking for Decision Makers</td>
<td>3.0</td>
</tr>
<tr>
<td>COMS 811: Managerial Communication</td>
<td>3.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Name &amp; Number</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Concentration:</strong> EVRN 616: Environmental Impact Assessment</td>
<td>3.0</td>
</tr>
</tbody>
</table>

(New course to be proposed)

<table>
<thead>
<tr>
<th>Course Name &amp; Number</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVRN 620: Environmental Politics and Policy</td>
<td>3.0</td>
</tr>
<tr>
<td>EVRN 538: Environmental Soil Physics and Chemicals</td>
<td>3.0</td>
</tr>
<tr>
<td>EVRN 611: Watershed, Land Use, and Ecosystems</td>
<td>3.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Name &amp; Number</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electives:</strong> EVRN 510: Advanced Environmental Applications in Geospatial Techniques</td>
<td>3.0</td>
</tr>
<tr>
<td>EVRN 656: Ecosystem Ecology</td>
<td>3.0</td>
</tr>
<tr>
<td>GEOL 751: Geology – Physical &amp; Transport Hydrogeology</td>
<td>4.0</td>
</tr>
<tr>
<td>PRVM 830: Environmental Health</td>
<td>3.0</td>
</tr>
<tr>
<td>PRVM 870: Environmental Health Law &amp; Policy</td>
<td>3.0</td>
</tr>
<tr>
<td>PRVM 871 Environmental Monitoring and Exposure Assessment</td>
<td>3.0</td>
</tr>
<tr>
<td>PRVM 874 Toxicology and Risk Assessment</td>
<td>3.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Name &amp; Number</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Practica:</strong> EVRN 590: Professional Science Masters Capstone</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Total 33.0
Fiscal Summary for the Proposed Academic Program

Institution: University of Kansas - Lawrence  
Proposed Program: Professional Science Masters  
(concentration in Environmental Assessment)

**Part I. Anticipated Enrollment**

<table>
<thead>
<tr>
<th></th>
<th>Implementation Year</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full-Time</td>
<td>Part-Time</td>
<td>Full-Time</td>
</tr>
<tr>
<td>A. Headcount</td>
<td>0</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>B. Total SCH taken by all students in the program</td>
<td>60</td>
<td></td>
<td>120</td>
</tr>
</tbody>
</table>

**Part II. Program Cost Projection**

A. In the implementation year, list all identifiable General Use costs to the academic unit(s) and how they will be funded. In subsequent years, please include only the additional amount budgeted.

<table>
<thead>
<tr>
<th>Base Budget</th>
<th>Implementation Year</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries</td>
<td>$ 80,000</td>
<td>$ 115,000</td>
<td>$ 130,000.00</td>
</tr>
<tr>
<td>OOE</td>
<td>9,000</td>
<td>9,000</td>
<td>11,000</td>
</tr>
<tr>
<td>Total</td>
<td>$ 89,000</td>
<td>$ 124,000</td>
<td>$ 141,000</td>
</tr>
</tbody>
</table>

Indicate source and amount of funds if other than internal reallocation:

Funding for the salaries and OOE will be from the 0.125 cent sales tax in Johnson County, KS (JCERT, Johnson County Education and Research Triangle) funds.

Revised: September, 2003

Approved: _____________________
Attachment I:

CURRICULUM OUTLINE
NEW DEGREE PROPOSAL
Professional Science Masters with a concentration in Environmental Assessment
Kansas Board of Regents

Rationale and Framework for all P.S.M. degrees – See Appendix A

CORE/PROFESSIONAL SKILLS: (12 credit hours)

PMGT 816: Project Management Fundamentals I (3): Managerial concepts and skills development in relation to the project-oriented business environment, project lifecycle, integrated project management, project selection, and project initiation. Focus is on management of a single project.

ENTR 701: Entrepreneurship - Starting Your Own Business (3): In this course the student examines the disciplines which comprise the critical success factors in entrepreneurship and develops a fundamental understanding of the basic skill set required to manage his/her own business. The course will emphasize the Entrepreneurial Process in which each of the following disciplines will be introduced so that the student understands meaning, interrelationship and the application of the subject matter. First the student will be introduced to entrepreneurship and the personal attributes which historically have produced successful entrepreneurs.

ACCT 7xx: Survey of Accounting (3): This course is an introduction to financial and managerial accounting. It also serves as a bridge to basic financial decision-making. It will introduce the concepts of business and the measurement systems used to control and evaluate business activities. It will also explore costing systems and the use of accounting data as a basis for management planning and decision making, using basic tools such as return on investment. (This course will be developed to the specific needs of the P.S.M. degrees and will be assigned a number once developed):

COMS 730: Writing & Speaking for Decision Makers (3): Theory and application of communication strategies for corporate communication. This course presents rhetorical analysis of organizational situations and audiences, focusing on corporate decision-makers. Included are informative and persuasive communications such as board presentations, requests for proposal and responses to RFPs, grant proposals, and persuasive presentations for adoption, implementation, or evaluation of organizational programs. Course is limited to Regents Center students only.

OR

COMS 811: Managerial Communication (3): This class examines the role of communication in organizations, specifically in the contexts and situations faced by managers in for-profit and not-for-profit organizations. We will integrate theory and practical approaches to address, among other topics, communication in hiring, providing and seeking feedback, working in teams, coaching, and dealing with diversity, conflict and ethics in the workplace.
SCIENCE COURSES: (18 credit hours)

Concentration (12 credit hours): Select from the following:

**EVRN 616: Environmental Impact Assessment (3) (NEW COURSE TO BE PROPOSED).** Overview of environmental laws and regulations: NEPA, Endangered Species Act, Migratory Bird Treaty Act, National Historic Preservation Act, Bald and Golden Eagle Protection Act, Clean Water Act, Clean Air Act, CERCLA, RCRA, Superfund, then focuses on the NEPA process, when NEPA is triggered, the difference between Environmental Impact Statements and Environmental Assessments, and how to write an EIA/EIS.

**EVRN 620: Environmental Politics and Policy (3).** Analysis of environmental politics and the formulation and implementation of environmental policy. Examines the history and development of environmental politics as well as current trends. Themes include interest groups, business interests, political institutions, and specific environmental policy issues.

**EVRN 538: Environmental Soil Physics and Chemicals (3).** This course examines the physical and chemical properties of soils and methods of evaluation. Physical topics include the movement of water, heat, gases, and solutes through soil. Chemistry topics include solid and solution speciation, mineral solubility, ion exchange, and oxidation reduction reactions in soils.

**EVRN 611: Watershed, Land Use, and Ecosystems (3).** Water quality issues are integrated with land use planning and the development of watershed management strategies. Interrelationships among the hydrologic cycle, atmospheric deposition, nutrient transformations and pesticide use are examined in regards to stream, lake, and groundwater quality.

Electives (6 credit hours). Select from the following:

**EVRN 510: Advanced Environmental Applications in Geospatial Techniques (3).** This course focuses on applying advanced geospatial mapping and analysis techniques to environmental issues. Course content may include lecture/lab time on advanced geospatial topics; a major class project, small-group projects, or individual project. The specific nature of projects will be driven largely by student interest and ability, as well as agency/center needs.

**EVRN 656: Ecosystem Ecology (3).** An introduction to the patterns and processes that affect terrestrial ecosystems. Emphasis is placed on understanding nutrient cycles (e.g., carbon, nitrogen, phosphorous), hydrologic cycles, and patterns of net primary productivity. The role of both natural and anthropogenic disturbances in structuring terrestrial ecosystems is examined in the context of global land-use patterns. (Same as BIOL 656.)

**GEOL 751: Geology – Physical & Transport Hydrogeology (4) (F/12:LawEdw).** A study of fluid flow in the subsurface including transport of constituents with the fluid. Physical transport will consider (1) the origin of basic parameters such as porosity and hydraulic conductivity, and their relationship to typical geologic materials, (2) basic equations of flow, such as Darcy's Law and the conservation equation, and (3) application of these concepts.
PRVM 830: Environmental Health (3). This course will identify specific health effects of environmental contaminants and discuss principles of prevention. Specific problem areas will include air and water pollution, solid waste disposal, food preservation, radiation, industrial hygiene, occupational diseases, chemical carcinogens accidents, an agricultural health and safety.

PRVM 870: Environmental Health Law & Policy (3): Prereq: PVRM 830. This is a survey course that will provide a broad, practical understanding of some important local, state, and federal environmental statutes, regulations, and case law. This course will cover the fundamentals of environmental law, examining the history, development, and current status of environmental law and federalism in the United States.

PRVM 871 Environmental Monitoring and Exposure Assessment (3) Prereq: PVRM 830. This course will examine the various techniques and analytical methods to measure environmental contamination in air, water, soils, and food in both indoor and outdoor environments. Students will learn to use measurement devices and instrumentation typically used to measure and analyze these environmental contaminants.

PRVM 874 Toxicology and Risk Assessment (3) Prereq: PVRM 800 and 830. This course will introduce students to basic toxicological concepts. Students will be provided opportunities to use these concepts to describe the underlying biochemical or physiological basis for health effects related to exposure to environmental toxicants and will practice interpreting the findings from student in the literature and critiquing studies.

CAPSTONE: (3 credit hours).

EVRN 590: Professional Science Masters Capstone (3). A culminating experience to develop a workforce project, producing a written report and presented orally to a committee that includes an industry member. The capstone serves as a culminating experience for the PSM degree. Students will develop an applied workforce project in the student’s place of employment for full time employees or an internship for full time students. The students will document their project in a written report and present their project to the Environmental Studies faculty (2), and the student’s employer or representative if practical.
APPENDIX A

Professional Science Masters degree overview and core course information

I. Definition:

The Professional Science Master’s (P.S.M.) degree is a unique professional degree grounded in natural science, technology, engineering, mathematics and/or computational sciences and designed to prepare students for direct entry into a variety of career options in industry, business, government, or non-profit organizations. P.S.M. programs prepare graduates for high-level careers in science that have a strong emphasis on such skill areas as management, policy, entrepreneurship, communication and project management. P.S.M. programs consist of two years of academic training in an emerging or interdisciplinary area, along with a professional component that may include internships and "cross-training" in workplace skills. All have been developed in concert with employers and are designed to dovetail into present and future professional career opportunities. As of September 2012, there are 291 PSMs nationwide, and only one in Kansas (See Appendix F for additional information on the Professional Science Masters degree from a national academic perspective).

II. Rationale:

There is a national trend to offer degrees in the sciences that include workforce “soft” skills such as communication, teamwork, and knowledge of business concepts. Scientific research in corporations typically involve team-based projects, and require someone with an understanding of the specific science needs and the ability to manage the project, understand costs, apply for grants, and communicate the project status to non-technical decision makers and shareholders.

Industry leaders in Johnson County were surveyed and interviewed by Patron Insight in 2007 and in 2010 and their feedback corresponds to this national trend. These leaders identified communication, entrepreneurial spirit, adaptability, and the ability to collaborate in a multicultural environment as critical skills beyond the needed technical skills typically developed in an advanced degree.

“Basic communication skills need to be matched with cultural awareness. It’s so critical these days in our business. We struggle globally, because people aren’t prepared to handle the challenge of communicating in other cultures.”

“Collaborative decision-making among groups is a critical skill, and it can be taught. Even people who are specialists in a field, such as engineering, need to develop an understanding of collaboration.”

“KU Edwards Campus could be helpful by preparing people for a project-based environment, training them in relationships and communications, and on cultural awareness, diversity and how to effectively work with a virtual team.”
Framework

a. **PSM Core 12 hours**

*All PSMs must include a core of business, communication, and project management skills. The following core/professional skills courses are common to all existing and proposed KU PSM programs:

- **PMGT 824** Project Management for Scientists and Technical Professionals (3)
- **ENTR 701** Entrepreneurship - Starting Your Own Business (3)
- **ACCT 7xx** Survey of Accounting (3)
- **COMS 730** Writing & Speaking for Decision Makers (3)
- OR
- **COMS 811** Managerial Communication (3)

b. **Concentration from College or School, not to exceed 12 hours**

*Once the College or School has a P.S.M., additional tracks/concentrations from that unit will only need to follow the approval process up to the Provost office and Graduate Studies. They will not need to go to the BOR if the concentrations are 12 hours or less.

c. **Related electives 6 hours**

d. **Capstone 3 hours**

The Capstone is a culminating experience to develop a workforce project, producing a written report and presented orally to a committee that includes an industry member. (and should be described as such in proposals). All PSM degree programs require a capstone and if a student is not already working in the chosen industry, an internship is required and should be related to the capstone. If student is working in the industry, the capstone can be a project for their company.

Total hours for degree: 33 hours
Concept for Professional Science Masters Programs at the University of Kansas Biological Survey
Common Core/Professional Skills courses + Discipline-specific Science courses
Appendix B

Regional Workforce Intelligence Network Occupation Report for the Kansas City Metro area.
KU Edwards Data Request

The following occupation reports were prepared using research tools, EMSI and WANTED Analystics. Reports include information on job openings, current, past and future projections of employment, wages, location quotients, educational attainment, existing education programs and staffing patterns.

Full Reports

Environmental Science and Protection Technicians, Including Health

Environmental Scientists and Specialists, Including Health

Geoscientists, Except Hydrologists and Geographers

Natural Sciences Managers

EMSI Data Sources
This report uses data from the following agencies: Kansas Department of Labor, Labor Market Information Services, Kansas Wage Survey; Missouri Department of Economic Development.
### Environmental Science and Protection Technicians, Including Health

**Occupation Facts for Kansas City MSA**

SOC 19-4091: Performs laboratory and field tests to monitor the environment and investigate sources of pollution, including those that affect health. Under direction of an environmental scientist or specialist, may collect samples of gases, soil, water, and other materials for testing and take corrective actions as assigned.

<table>
<thead>
<tr>
<th>Annual Openings Estimate (2011)</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Related Completions (2010)</td>
<td>16</td>
</tr>
<tr>
<td>Online Job Postings for Past 90 Days (WANTED)</td>
<td>22</td>
</tr>
</tbody>
</table>

#### Employment by Gender

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>54%</td>
</tr>
<tr>
<td>Female</td>
<td>46%</td>
</tr>
</tbody>
</table>

#### Employment by Age

<table>
<thead>
<tr>
<th>Age</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>14-18</td>
<td>0%</td>
</tr>
<tr>
<td>19-24</td>
<td>24%</td>
</tr>
<tr>
<td>25-44</td>
<td>33%</td>
</tr>
<tr>
<td>45-64</td>
<td>34%</td>
</tr>
<tr>
<td>65+</td>
<td>9%</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>183</td>
<td>6.9%</td>
</tr>
<tr>
<td>Location Quotient: 0.71</td>
<td>National: 9.4%</td>
</tr>
</tbody>
</table>

| $12.18/hr | $17.82/hr | $28.95/hr |
Regional Trends

<table>
<thead>
<tr>
<th>Region</th>
<th>2007 Jobs</th>
<th>2012 Jobs</th>
<th>% Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kansas City</td>
<td>178</td>
<td>190</td>
<td>6.9%</td>
</tr>
<tr>
<td>U.S</td>
<td>33,991</td>
<td>37,202</td>
<td>9.4%</td>
</tr>
</tbody>
</table>

**Educational Attainment**

<table>
<thead>
<tr>
<th>Level</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctoral or professional degree</td>
<td>4%</td>
</tr>
<tr>
<td>Master's degree</td>
<td>9%</td>
</tr>
<tr>
<td>Bachelor's degree</td>
<td>30%</td>
</tr>
<tr>
<td>Associate's degree</td>
<td>13%</td>
</tr>
<tr>
<td>Some college, no degree</td>
<td>24%</td>
</tr>
<tr>
<td>High school diploma or equivalent</td>
<td>17%</td>
</tr>
<tr>
<td>Less than high school diploma</td>
<td>3%</td>
</tr>
</tbody>
</table>
### Educational Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Science (03.0104)</td>
<td>0</td>
<td>12</td>
<td>13</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Science Technologies/Technicians, Other (41.9999)</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

### Inverse Staffing Patterns

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Local government (930000)</td>
<td>37</td>
<td>20.3%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Administrative Management and General Management Consulting Services (541611)</td>
<td>18</td>
<td>9.6%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Engineering Services (541330)</td>
<td>17</td>
<td>9.0%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Crude Petroleum and Natural Gas Extraction (211111)</td>
<td>16</td>
<td>8.5%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Testing Laboratories (541380)</td>
<td>15</td>
<td>8.2%</td>
<td>1.8%</td>
</tr>
</tbody>
</table>

### WANTED Analytics

Total Job Postings Past 90 Days: 22

Top Employers: Stericycle, PSC, Providence Medical Center, Johnson Controls, WaterOne, Veolia Environment, Truman Medical Centers, Fresenius Medical Care
Environmental Scientists and Specialists, Including Health
Occupation Facts for Kansas City MSA
SOC 19-2041: Conduct research or perform investigation for the purpose of identifying, abating, or eliminating sources of pollutants or hazards that affect either the environment or the health of the population. Utilizing knowledge of various scientific disciplines may collect, synthesize, study, report, and take action based on data derived from measurements or observations of air, food, soil, water, and other sources.

<table>
<thead>
<tr>
<th>Annual Openings Estimate (2011)</th>
<th>38</th>
</tr>
</thead>
<tbody>
<tr>
<td>Related Completions (2010)</td>
<td>15</td>
</tr>
<tr>
<td>Online Job Postings for Past 90 Days (WANTED)</td>
<td>11</td>
</tr>
</tbody>
</table>

**Employment by Gender**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>73%</td>
</tr>
<tr>
<td>Female</td>
<td>27%</td>
</tr>
</tbody>
</table>

**Employment by Age**

<table>
<thead>
<tr>
<th>Age</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-18</td>
<td>0%</td>
</tr>
<tr>
<td>19-24</td>
<td>4%</td>
</tr>
<tr>
<td>25-44</td>
<td>41%</td>
</tr>
<tr>
<td>45-64</td>
<td>50%</td>
</tr>
<tr>
<td>65+</td>
<td>6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>598</td>
<td>4.2%</td>
<td>$25.94/hr</td>
</tr>
<tr>
<td>Location Quotient: 0.91</td>
<td>National: 6.4%</td>
<td>National: $28.06/hr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10th Percentile Wage (2011)</th>
<th>16.60/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median Wage (2011)</td>
<td>25.94/hr</td>
</tr>
<tr>
<td>90th Percentile Wage (2011)</td>
<td>48.52/hr</td>
</tr>
</tbody>
</table>
Regional Trends

<table>
<thead>
<tr>
<th>Region</th>
<th>2007 Jobs</th>
<th>2012 Jobs</th>
<th>% Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kansas City</td>
<td>594</td>
<td>619</td>
<td>4.2%</td>
</tr>
<tr>
<td>U.S</td>
<td>88,728</td>
<td>94,435</td>
<td>6.4%</td>
</tr>
</tbody>
</table>

Educational Attainment

<table>
<thead>
<tr>
<th>Educational Attainment</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctoral or professional degree</td>
<td>10%</td>
</tr>
<tr>
<td>Master's degree</td>
<td>35%</td>
</tr>
<tr>
<td>Bachelor's degree</td>
<td>48%</td>
</tr>
<tr>
<td>Associate's degree</td>
<td>3%</td>
</tr>
<tr>
<td>Some college, no degree</td>
<td>3%</td>
</tr>
<tr>
<td>High school diploma or equivalent</td>
<td>1%</td>
</tr>
<tr>
<td>Less than high school diploma</td>
<td>0%</td>
</tr>
</tbody>
</table>

Educational Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Science (03.0104)</td>
<td>0</td>
<td>12</td>
<td>13</td>
<td>16</td>
<td>15</td>
</tr>
</tbody>
</table>
## Inverse Staffing Patterns

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Services (541330)</td>
<td>99</td>
<td>16.6%</td>
<td>0.8%</td>
</tr>
<tr>
<td>State government (920000)</td>
<td>84</td>
<td>14.1%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Local government (930000)</td>
<td>81</td>
<td>13.6%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Federal government, civilian, except postal service (911000)</td>
<td>68</td>
<td>11.3%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Administrative Management and General Management Consulting Services (541611)</td>
<td>60</td>
<td>10.0%</td>
<td>1.1%</td>
</tr>
</tbody>
</table>

### WANTED Analytics

**Total Job Postings Past 90 Days**: 11

**Top Employers**: Black & Veatch, Kansas Civil Service Jobs, State of Arkansas, Eastern Research Group, TranSystems, ERG, Blackstone Environmental
Geoscientists, Except Hydrologists and Geographers
Occupation Facts for Kansas City MSA
SOC 19-2042: Study the composition, structure, and other physical aspects of the earth. May use geological, physics, and mathematics knowledge in exploration for oil, gas, minerals, or underground water; or in waste disposal, land reclamation, or other environmental problems. May study the earth’s internal composition, atmospheres, oceans, and its magnetic, electrical, and gravitational forces. Includes mineralogists, crystallographers, paleontologists, stratigraphers, geodesists, and seismologists.

<table>
<thead>
<tr>
<th>Annual Openings Estimate (2011)</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Related Completions (2010)</td>
<td>4</td>
</tr>
<tr>
<td>Online Job Postings for Past 90 Days (WANTED)</td>
<td>7</td>
</tr>
</tbody>
</table>

**Employment by Gender**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>77%</td>
</tr>
<tr>
<td>Female</td>
<td>23%</td>
</tr>
</tbody>
</table>

**Employment by Age**

<table>
<thead>
<tr>
<th>Age</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-18</td>
<td>0%</td>
</tr>
<tr>
<td>19-24</td>
<td>0%</td>
</tr>
<tr>
<td>25-44</td>
<td>49%</td>
</tr>
<tr>
<td>45-64</td>
<td>31%</td>
</tr>
<tr>
<td>65+</td>
<td>20%</td>
</tr>
</tbody>
</table>

**Jobs (2011)**

130

**Growth (2007-2012)**

22.3%

**Location Quotient**: 0.42

**National**: 19.2%

**Median Wage (2011)**

$22.89/hr

**National**: $32.85/hr

**10th Percentile Wage (2011)**

$13.58/hr

**Median Wage (2011)**

$22.89/hr

**90th Percentile Wage (2011)**

$41.34/hr
Regional Trends

<table>
<thead>
<tr>
<th>Region</th>
<th>2007 Jobs</th>
<th>2012 Jobs</th>
<th>% Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kansas City</td>
<td>111</td>
<td>136</td>
<td>22.3%</td>
</tr>
<tr>
<td>U.S</td>
<td>37,168</td>
<td>44,312</td>
<td>19.2%</td>
</tr>
</tbody>
</table>

Educational Attainment

<table>
<thead>
<tr>
<th>Degree</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctoral or professional degree</td>
<td>10%</td>
</tr>
<tr>
<td>Master's degree</td>
<td>35%</td>
</tr>
<tr>
<td>Bachelor's degree</td>
<td>48%</td>
</tr>
<tr>
<td>Associate's degree</td>
<td>3%</td>
</tr>
<tr>
<td>Some college, no degree</td>
<td>3%</td>
</tr>
<tr>
<td>High school diploma or equivalent</td>
<td>1%</td>
</tr>
<tr>
<td>Less than high school diploma</td>
<td>0%</td>
</tr>
</tbody>
</table>
### Educational Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology/Earth Science, General (40.0601)</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Geological and Earth Sciences/Geosciences, Other (40.0699)</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

### Inverse Staffing Patterns

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Petroleum and Natural Gas Extraction (211111)</td>
<td>46</td>
<td>35.8%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Engineering Services (541330)</td>
<td>28</td>
<td>21.5%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Federal government, civilian, except postal service (911000)</td>
<td>11</td>
<td>8.7%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Administrative Management and General Management Consulting Services (541611)</td>
<td>7</td>
<td>5.7%</td>
<td>0.1%</td>
</tr>
<tr>
<td>State government (920000)</td>
<td>6</td>
<td>4.6%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

### WANTED Analytics

- **Total Job Postings Past 90 Days**: 7
- **Top Employers**: Burns & McDonnell
Natural Sciences Managers
Occupation Facts for Kansas City MSA
SOC 11-9121: Plan, direct, or coordinate activities in such fields as life sciences, physical sciences, mathematics, statistics, and research and development in these fields.

Annual Openings Estimate (2011) 11
Related Completions (2010) 417
Online Job Postings for Past 90 Days (WANTED) 104

Employment by Gender
Male 65%  
Female 35%

Employment by Age
14-18 0%  
19-24 18%  
25-44 20%  
45-64 58%  
65+ 4%

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>207</td>
<td>8.8%</td>
<td>$44.91/hr</td>
</tr>
<tr>
<td>Location Quotient: 0.61</td>
<td>National: 6.3%</td>
<td>National: $52.42/hr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$29.61/hr</td>
<td>$44.91/hr</td>
<td>$74.01/hr</td>
</tr>
</tbody>
</table>
Regional Trends

<table>
<thead>
<tr>
<th>Region</th>
<th>2007 Jobs</th>
<th>2012 Jobs</th>
<th>% Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kansas City</td>
<td>194</td>
<td>211</td>
<td>8.8%</td>
</tr>
<tr>
<td>U.S</td>
<td>45,310</td>
<td>48,165</td>
<td>6.3%</td>
</tr>
</tbody>
</table>

**Educational Attainment**

- Doctoral or professional degree: 34%
- Master's degree: 26%
- Bachelor's degree: 33%
- Associate's degree: 1%
- Some college, no degree: 4%
- High school diploma or equivalent: 2%
- Less than high school diploma: 1%
Educational Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology/Biological Sciences, General (26.0101)</td>
<td>189</td>
<td>220</td>
<td>162</td>
<td>151</td>
<td>176</td>
</tr>
<tr>
<td>Chemistry, General (40.0501)</td>
<td>67</td>
<td>53</td>
<td>80</td>
<td>75</td>
<td>96</td>
</tr>
<tr>
<td>Biological and Biomedical Sciences, Other (26.9999)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>38</td>
</tr>
<tr>
<td>Mathematics, General (27.0101)</td>
<td>47</td>
<td>41</td>
<td>15</td>
<td>39</td>
<td>25</td>
</tr>
<tr>
<td>Physics, General (40.0801)</td>
<td>10</td>
<td>13</td>
<td>13</td>
<td>22</td>
<td>21</td>
</tr>
</tbody>
</table>

Inverse Staffing Patterns

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal government, civilian, except postal service (911000)</td>
<td>70</td>
<td>33.7%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Research and Development in Biotechnology (541711)</td>
<td>25</td>
<td>12.0%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology) (541712)</td>
<td>17</td>
<td>8.0%</td>
<td>1.2%</td>
</tr>
<tr>
<td>State government (920000)</td>
<td>11</td>
<td>5.3%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Corporate, Subsidiary, and Regional Managing Offices (551114)</td>
<td>11</td>
<td>5.3%</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

WANTED Analytics

Total Job Postings Past 90 Days 104

Top Employers Quintiles, KU Hospital, PRA International, Celgene, Bayer, Cardinal Health, United BioSource Corporation, IBM, Truman Medical Centers, CGI Technologies and Solutions
Appendix C

Bureau of Labor Statistics national and regional occupational data for the environmental sciences and related fields
Environmental Scientists and Specialists

Significant Points

- Federal, State, and local governments employ 44 percent of all environmental scientists and specialists.
- A bachelor’s degree in any life or physical science is generally sufficient for most entry-level positions, although many employers prefer a master’s degree.
- Job prospects are expected to be favorable, particularly for environmental health workers in State and local government.

Nature of the Work

Environmental scientists and specialists use their knowledge of the natural sciences to protect the environment by identifying problems and finding solutions that minimize hazards to the health of the environment and the population. They analyze measurements or observations of air, food, water, and soil to determine the way to clean and preserve the environment. Understanding the issues involved in protecting the environment—degradation, conservation, recycling, and replenishment—is central to the work of environmental scientists. They often use this understanding to design and monitor waste disposal sites, preserve water supplies, and reclaim contaminated land and water. They also write risk assessments, describing the likely affect of construction and other environmental changes; write technical proposals; and give presentations to managers and regulators.

The Federal Government and most State and local governments enact regulations to ensure that there is clean air to breathe, safe water to drink, and no hazardous materials in the soil. The regulations also place limits on development, particularly near sensitive parts of the ecosystem, such as wetlands. Many environmental scientists and specialists work for the government, ensuring that these regulations are followed and limiting the impact of human activity on the environment. Others monitor environmental impacts on the health of the population, checking for risks of disease and providing information about health hazards.

Environmental scientists also work with private companies to help them comply with environmental regulations and policies. They are usually hired by consulting firms to solve problems. Most consulting firms fall into two categories—large multidisciplinary engineering companies, the largest of which may employ thousands of workers, and small niche firms that may employ only a few workers. When looking for jobs, environmental scientists should consider the type of firm and the scope of the projects it undertakes. In larger firms, environmental scientists are more likely to engage in large, long-term projects in which they will work with people in other scientific disciplines. In smaller specialty firms, however, they work more often with business professionals and clients in government and the private sector.

Environmental scientists who work on policy formation may help identify ways that human behavior can be modified in the future to avoid such problems as ground-water contamination and depletion of the ozone layer. Some environmental scientists work in managerial positions, usually after spending some time performing research or learning about environmental laws and regulations.

Many environmental scientists do work and have training that is similar to other physical or life scientists, but they focus on environmental issues. Many specialize in subfields such as environmental ecology and conservation, environmental chemistry, environmental biology, or fisheries science. Specialties affect the specific activities that environmental scientists perform, although recent understandings of the interconnectedness of life processes have blurred some traditional classifications. For example, environmental ecologists study the relationships between organisms and their environments and the effects of factors such as population size, pollutants, rainfall, temperature, and altitude, on both. They may collect, study, and report data on air, soil, and water using their knowledge of various scientific disciplines. Ecological modelers study ecosystems, pollution control, and resource management using mathematical modeling, systems analysis, thermodynamics, and computer techniques. Environmental chemists study the toxicity of various chemicals, that is, how those chemicals affect plants, animals, and people. (Information on geoscientists and hydrologists, who also study the Earth, is located elsewhere in the Handbook.)

Environmental scientists in research positions with the Federal Government or in colleges and universities often have to find funding for their work by writing grant proposals. Consultants face similar pressures to market their skills and write proposals so that they will have steady work.

Work environment. Many entry-level environmental scientists and specialists spend a significant amount of time in the field, while more experienced workers generally devote...
more time to office or laboratory work. Some environmental scientists, such as environmental ecologists and environmental chemists, often take field trips that involve physical activity. Environmental scientists in the field may work in warm or cold climates, in all kinds of weather. Travel often is required to meet with prospective clients.

Researchers and consultants might face stress when looking for funding. Occasionally, those who write technical reports to business clients and regulators may be under pressure to meet deadlines and thus have to work long hours.

**Training, Other Qualifications, and Advancement**

A bachelor’s degree is sufficient for most jobs in government and private sector companies, although a master’s degree is often preferred. A Ph.D. is usually only necessary for jobs in college teaching or research.

**Education and training.** A bachelor’s degree in an earth science is adequate for entry-level positions, although many companies prefer to hire environmental scientists with a master’s degree in environmental science or a related natural science. A doctoral degree generally is necessary only for college teaching and some research positions. Some environmental scientists and specialists have a degree in environmental science, but many earn degrees in biology, chemistry, physics, or the geosciences and then apply their education to the environment. They often need research or work experience related to environmental science.

A bachelor’s degree in environmental science offers an interdisciplinary approach to the natural sciences, with an emphasis on biology, chemistry, and geology. Undergraduate environmental science majors typically focus on data analysis and physical geography, which are particularly useful in studying pollution abatement, water resources, or ecosystem protection, restoration, and management. Understanding the geochemistry of inorganic compounds is becoming increasingly important in developing remediation goals. Students interested in working in the environmental or regulatory fields, either in environmental consulting firms or for Federal or State governments, should take courses in hydrology, hazardous-waste management, environmental legislation, chemistry, fluid mechanics, and geologic logging, which is the gathering of geologic data. An understanding of environmental regulations and government permit issues also is valuable.

For environmental scientists and specialists who consult, courses in business, finance, marketing, or economics may be useful. In addition, combining environmental science training with other disciplines such as engineering or business, qualifies these scientists for the widest range of jobs.

**Other qualifications.** Computer skills are essential for prospective environmental scientists. Students who have some experience with computer modeling, data analysis and integration, digital mapping, remote sensing, and Geographic Information Systems (GIS) will be the most prepared to enter the job market.

Environmental scientists and specialists usually work as part of a team with other scientists, engineers, and technicians, and they must often write technical reports and research proposals that communicate their research results or ideas to company managers, regulators, and the public. Environmental health specialists also work closely with the public, providing and collecting information on public health risks. As a result, strong oral and written communication skills are essential.

Advancement. Environmental scientists and specialists often begin their careers as field analysts or as research assistants or technicians in laboratories or offices. They are given more difficult assignments and more autonomy as they gain experience. Eventually, they may be promoted to project leader, program manager, or some other management and research position. (Information on engineering and natural sciences managers is located elsewhere in the *Handbook.*)

**Employment**

Environmental scientists and specialists held about 85,900 jobs in 2008. An additional 6,200 jobs were held by environmental science faculty; these workers are covered in the statement on teachers—postsecondary elsewhere in the *Handbook.*

About 37 percent of environmental scientists were employed in State and local governments; 21 percent in management, scientific, and technical consulting services; 15 percent in architectural, engineering and related services; and 7 percent in the Federal Government, primarily in the Environmental Protection Agency (EPA) and the Department of Defense.

**Job Outlook**

Employment is expected to grow much faster than the average for all occupations. Job prospects are expected to be favorable, particularly in State and local government.

**Employment change.** Employment of environmental scientists and specialists is expected to increase by 28 percent between 2008 and 2018, much faster than the average for all occupations. Job growth should be strongest in private-sector consulting firms. Growth in employment will be spurred largely by the increasing demands placed on the environment by population growth and increasing awareness of the problems caused by environmental degradation. Further demand should result from the need to comply with complex environmental laws and regulations, particularly those regarding ground-water decontamination and clean air.

Much job growth will result from a continued need to monitor the quality of the environment, to interpret the impact of human actions on terrestrial and aquatic ecosystems, and to develop strategies for restoring ecosystems. In addition, environmental
scientists will be needed to help planners develop and construct buildings, transportation corridors, and utilities that protect water resources and reflect efficient and beneficial land use.

Many environmental scientists and specialists work in consulting. Consulting firms have hired these scientists to help businesses and government address issues related to underground tanks, land disposal areas, and other hazardous-waste-management facilities. Currently, environmental consulting is evolving from investigations to creating remediation and engineering solutions. At the same time, the regulatory climate is moving from a rigid structure to a more flexible risk-based approach. These factors, coupled with new Federal and State initiatives that integrate environmental activities into the business process itself, will result in a greater focus on waste minimization, resource recovery, pollution prevention, and the consideration of environmental effects during product development. This shift in focus to preventive management will provide many new opportunities for environmental scientists in consulting roles.

**Job prospects.** In addition to job openings due to growth, there will be additional demand for new environmental scientists to replace those who retire, advance to management positions, or change careers. Job prospects for environmental scientists will be good, particularly for jobs in State and local government.

During periods of economic recession, layoffs of environmental scientists and specialists may occur in consulting firms, particularly when there is a slowdown in new construction; layoffs are much less likely in government.

**Earnings**

Median annual wages of environmental scientists and specialists were $59,750 in May 2008. The middle 50 percent earned between $45,340 and $78,980. The lowest 10 percent earned less than $36,310, and the highest 10 percent earned more than $102,610.

According to the National Association of Colleges and Employers, beginning salary offers in July 2009 for graduates with bachelor’s degrees in an environmental science averaged $39,160 a year.

**Related Occupations**

Other occupations that deal with preserving or researching the natural environment include:

- Atmospheric scientists
- Biological scientists
- Chemists and materials scientists
- Conservation scientists and foresters
- Engineering technicians
- Engineers
- Epidemiologists
- Geoscientists and hydrologists
- Physicists and astronomers
- Science technicians
- Surveyors, cartographers, photogrammetrists, and surveying and mapping technicians

**Sources of Additional Information**

Information on training and career opportunities for environmental scientists and specialists is available from:

- American Geological Institute, 4220 King St., Alexandria, VA 22302. Internet: [http://www.agiweb.org](http://www.agiweb.org)

Information on obtaining a position as an environmental protection specialist with the Federal Government is available from the Office of Personnel Management through USAJOBS, the Federal Government’s official employment information system. This resource for locating and applying for job opportunities can be accessed through the Internet at [http://www.usajobs.opm.gov](http://www.usajobs.opm.gov) or through an interactive voice response telephone system at (703) 724-1850 or TDD (978) 461-8404. These numbers are not toll free, and charges may result.

The Occupational Information Network (O*NET) provides information on a wide range of occupational characteristics. Links to O*NET appear at the end of the Internet version of this occupational statement, accessible at [http://www.bls.gov/ooh/ocos311.htm](http://www.bls.gov/ooh/ocos311.htm)
## Bureau of Labor Statistics
### Occupational Data for Greater Kansas City Metropolitan Area, 2010

<table>
<thead>
<tr>
<th>STATE</th>
<th>AREA</th>
<th>METRO AREA</th>
<th>OCCUPATIONAL CODE</th>
<th>OCCUPATIONAL TITLE</th>
<th>TOTAL EMPLOYMENT</th>
<th>MEAN SALARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>17-1021</td>
<td>Cartographers and Photogrammetrists</td>
<td>120</td>
<td>$55,740</td>
</tr>
<tr>
<td>KS</td>
<td>45820</td>
<td>Topeka, KS</td>
<td>17-1022</td>
<td>Surveyors</td>
<td>60</td>
<td>$51,270</td>
</tr>
<tr>
<td>KS</td>
<td>48620</td>
<td>Wichita, KS</td>
<td>17-1022</td>
<td>Surveyors</td>
<td>80</td>
<td>$36,090</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>17-1022</td>
<td>Surveyors</td>
<td>310</td>
<td>$45,610</td>
</tr>
<tr>
<td>KS</td>
<td>45820</td>
<td>Topeka, KS</td>
<td>17-2081</td>
<td>Environmental Engineers</td>
<td>60</td>
<td>$71,270</td>
</tr>
<tr>
<td>KS</td>
<td>48620</td>
<td>Wichita, KS</td>
<td>17-2081</td>
<td>Environmental Engineers</td>
<td>40</td>
<td>$84,450</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>17-2081</td>
<td>Environmental Engineers</td>
<td>350</td>
<td>$79,190</td>
</tr>
<tr>
<td>KS</td>
<td>48620</td>
<td>Wichita, KS</td>
<td>17-3029</td>
<td>Engineering Technicians, Except Drafters, All Other</td>
<td>**</td>
<td>$77,520</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>17-3029</td>
<td>Engineering Technicians, Except Drafters, All Other</td>
<td>150</td>
<td>$60,720</td>
</tr>
<tr>
<td>KS</td>
<td>29940</td>
<td>Lawrence, KS</td>
<td>17-3031</td>
<td>Surveying and Mapping Technicians</td>
<td>60</td>
<td>$33,650</td>
</tr>
<tr>
<td>KS</td>
<td>31740</td>
<td>Manhattan, KS</td>
<td>17-3031</td>
<td>Surveying and Mapping Technicians</td>
<td>30</td>
<td>$34,260</td>
</tr>
<tr>
<td>KS</td>
<td>48620</td>
<td>Wichita, KS</td>
<td>17-3031</td>
<td>Surveying and Mapping Technicians</td>
<td>50</td>
<td>$37,360</td>
</tr>
<tr>
<td>KS</td>
<td>48620</td>
<td>Wichita, KS</td>
<td>17-3031</td>
<td>Surveying and Mapping Technicians</td>
<td>90</td>
<td>$39,390</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>17-3031</td>
<td>Surveying and Mapping Technicians</td>
<td>310</td>
<td>$40,400</td>
</tr>
<tr>
<td>KS</td>
<td>31740</td>
<td>Manhattan, KS</td>
<td>19-1013</td>
<td>Soil and Plant Scientists</td>
<td>30</td>
<td>$59,950</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>19-1013</td>
<td>Soil and Plant Scientists</td>
<td>30</td>
<td>$66,010</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>19-1021</td>
<td>Biochemists and Biophysicists</td>
<td>**</td>
<td>$50,060</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>19-1023</td>
<td>Zoologists and Wildlife Biologists</td>
<td>**</td>
<td>$47,020</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>19-1029</td>
<td>Biological Scientists, All Other</td>
<td>120</td>
<td>$71,640</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>19-1031</td>
<td>Conservation Scientists</td>
<td>100</td>
<td>$45,750</td>
</tr>
<tr>
<td>KS</td>
<td>31740</td>
<td>Manhattan, KS</td>
<td>19-2041</td>
<td>Environmental Scientists and Specialists, Including Health</td>
<td>40</td>
<td>$53,610</td>
</tr>
<tr>
<td>KS</td>
<td>45820</td>
<td>Topeka, KS</td>
<td>19-2041</td>
<td>Environmental Scientists and Specialists, Including Health</td>
<td>250</td>
<td>$51,620</td>
</tr>
<tr>
<td>KS</td>
<td>48620</td>
<td>Wichita, KS</td>
<td>19-2041</td>
<td>Environmental Scientists and Specialists, Including Health</td>
<td>90</td>
<td>$54,990</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>19-2041</td>
<td>Environmental Scientists and Specialists, Including Health</td>
<td>550</td>
<td>$62,280</td>
</tr>
<tr>
<td>KS</td>
<td>45820</td>
<td>Topeka, KS</td>
<td>19-2042</td>
<td>Geoscientists, Except Hydrologists and Geographers</td>
<td>50</td>
<td>$48,200</td>
</tr>
<tr>
<td>KS</td>
<td>48620</td>
<td>Wichita, KS</td>
<td>19-2042</td>
<td>Geoscientists, Except Hydrologists and Geographers</td>
<td>60</td>
<td>$68,450</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>19-2042</td>
<td>Geoscientists, Except Hydrologists and Geographers</td>
<td>100</td>
<td>$75,580</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>19-2043</td>
<td>Hydrologists</td>
<td>40</td>
<td>$79,190</td>
</tr>
<tr>
<td>KS</td>
<td>45820</td>
<td>Topeka, KS</td>
<td>19-3051</td>
<td>Urban and Regional Planners</td>
<td>40</td>
<td>$61,320</td>
</tr>
<tr>
<td>KS</td>
<td>48620</td>
<td>Wichita, KS</td>
<td>19-3051</td>
<td>Urban and Regional Planners</td>
<td>30</td>
<td>$62,590</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>19-3051</td>
<td>Urban and Regional Planners</td>
<td>220</td>
<td>$55,930</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>19-4021</td>
<td>Biological Technicians</td>
<td>220</td>
<td>$39,090</td>
</tr>
<tr>
<td>KS</td>
<td>31740</td>
<td>Manhattan, KS</td>
<td>19-4091</td>
<td>Environmental Science and Protection Technicians, Including Health</td>
<td>**</td>
<td>$65,940</td>
</tr>
<tr>
<td>KS</td>
<td>45820</td>
<td>Topeka, KS</td>
<td>19-4091</td>
<td>Environmental Science and Protection Technicians, Including Health</td>
<td>30</td>
<td>$39,830</td>
</tr>
<tr>
<td>MO</td>
<td>28140</td>
<td>Kansas City, MO-KS</td>
<td>19-4091</td>
<td>Environmental Science and Protection Technicians, Including Health</td>
<td>160</td>
<td>$41,160</td>
</tr>
</tbody>
</table>

4,350 $55,632
Appendix D

CVs of Dr. Brown and Dr. Jakubauskas
J. Christopher Brown

Department of Geography
223 Lindley Hall
University of Kansas
Lawrence, KS 66045

(785) 864-5543 (office)
(785) 864-5378 (fax)
jcbrown2@ku.edu

Ph.D. Geography, 1999
University of California, Los Angeles
Dissertation – Beekeeping in the Amazon: Rural Development, Conservation, and Participation in Rondonia, Brazil

M.A. Latin American Studies, 1992
University of Kansas, Lawrence

B.A. Biology, 1989
University of Kansas, Lawrence

Positions

Director, The Environmental Studies Program, University of Kansas, 2008-present.

Associate Professor, Department of Geography and the Environmental Studies Program, University of Kansas, 2007-present.

Assistant Professor, Department of Geography and the Environmental Studies Program, University of Kansas, 2001-2007.

Lecturer, Department of Geography, University of California, Los Angeles, CA 1999-2001.

Lecturer, Department of Geography, Santa Monica College, Santa Monica, CA, 1999-2001.

Research and Teaching Interests

Political and ecological dynamics of development and conservation, biogeography, development institutions and policy, NGOs, human-environment relations, Latin America, Amazonia, Brazil.

Publications – authors in italics are graduate students


**Research Grants**

**2011** EMBRAPA (roughly Brazil’s equivalent of the USDA). Methodology for mapping agriculture in Brazil. 5-year grant. I am a foreign collaborator on the project with research teams from EMBRAPA. $305,000.

**2010** The Commons at the University of Kansas. Putting global commodity chains in their place: a KU-Mongolia initiative to mitigate the socio-cultural and environmental effects of mining. PI, with co-Is John Kennedy (Political Science) and Dave Fowle (Geology). $5000.

**2009** NSF-EPSCoR Grant EPS-0903806, “Climate Change and Energy: Basic Science, Impacts, and Mitigation,” 5-yr grant awarded $ 20,000,000; Co-I with approximately 60 other researchers at KU, K-State, Wichita State, Emporia State.

**2008** EMBRAPA. Agricultural intensification in production areas of soybean and sugar cane: territoriality, sustainability, and competitiveness. I am a foreign collaborator on the project with research teams from EMBRAPA. $156,521.

**2004** University of Kansas General Research Fund. Expansion of soybean cultivation in the Brazilian Amazon. $8,000.

**2001** New Faculty General Research Fund seed grant. Expansion of soybean cultivation in the Brazilian Amazon. $10,000.

**2000** NSF Grant SES 00-99097. International Funding, Local NGOs, and Electoral Outcomes. David Brown, J. Christopher Brown and Scott Desposato. $154,921.

**1996-1997** Fulbright Fellowship. Dissertation Field Research in Rondônia, Brazil.


**1995** Organization of American States Fellowship. Pre-Dissertation Research at the University of São Paulo, Brazil (stingless bee taxonomy and ecology) and pilot research at field site.

**1995** Klein Award for International Research. UC-Santa Barbara.
J. Christopher Brown

1995Latin American Studies Small Grant. UCLA, Pre-dissertation field research in Brazil.

1993Tinker Foundation Travel Grant and Latin American Studies Small Grant. UCLA. Pre-dissertation field research in Brazil.

**Fellowships**


1998Henry Bruman Fellowship. Department of Geography, UCLA.

1993-1994Title VI Fellowship for Foreign Language and Area Studies Training. UCLA.


**Awards and Honors**

2008John C. Wright Graduate Mentor Award, University of Kansas.

2006W.T. Kemper Fellowship for Teaching Excellence, University of Kansas.

2003H.O.P.E. (Honor for an Outstanding Progressive Educator) award nominee, University of Kansas.

2003Center for Teaching Excellence Faculty Fellow, University of Kansas.


**Professional Presentations**


Decentralization of development in the Brazilian Amazon, and Soybean production and deforestation in the Brazilian Amazon. Missouri Southern State University Brazil Lecture Series, Joplin, MO, 2010.

The soy moratorium and the end of deforestation in the Amazon. The Center for Iberian & Latin American Studies (CILAS) at the University of California, San Diego 2010.


The Use of MODIS 250 m Data in Agricultural Monitoring in Brazil. AAG Annual Meeting, Boston. 2008.


The Moral Geography of Development in the Amazon. AAG Annual Meeting, San Francisco. 2007.


There’s nothing inherent about scale: Political ecology, the local trap, and the politics of development in the Brazilian Amazon. Invited speaker at Texas A&M Department of Geography Colloquium. 2005.


Teaching Amazonia: Giving Students a Way to Locate Environmental Issues. Invited


Panelist with visiting speaker Derrick Jensen, and others, on the health of the global environment. Sponsored by ENVIRONS. University of Kansas. 2003.


Left turn on green?: Unintended consequences of international funding for sustainable development in Brazil. Department of Political Science Colloquium Series, University of Kansas. 2003.


There’s nothing inherent about scale: Political ecology, the local trap, and the politics of development in the Brazilian Amazon. Association of American Geographers Annual Meeting, Los Angeles. 2002.


Responding to deforestation: nature, social relations, and the promise of sustainable development in Rondonia, Brazil. Department of Geography Colloquium Series, University of Washington, Seattle. 2001.

Responding to deforestation: nature, social relations, and the promise of sustainable development in Rondonia, Brazil. Department of Geography Colloquium, University of Oklahoma. 2001.

Corruption and the discourses of sustainable development. UCLA Latin American Center’s

Putting local environmental protest in its place. Invited presentation in the workshop “Environmental protest around the globe.” German Historical Institute and Florida State University, Tallahassee. 2000.

Responding to deforestation: nature, social relations, and the promise of sustainable development in Rondonia, Brazil. Department of Geography Colloquium Series, University of Washington, Seattle and University of Oklahoma. 2000.


The Landscape of Sustainable Development in Rondonia, Brazil. Conference of Latin Americanist Geographers Meeting, Santa Fe. 1998.


Biogeography and Human Use of Social Bees in the Amazon. [In Portuguese] Two-day lecture and field course given at the Federal University of Rondonia, Porto Velho, Brazil. 1997.

Geographic Approaches to the Study of Bees and Beekeeping. [In Portuguese] Department of Genetics, Biology, and Ecology, University of São Paulo-Ribeirão Preto, Brazil. 1995.

Conservation and Development in the Brazilian Amazon. Interdisciplinary Graduate Seminar on Brazilian National Identity, Latin American Center, UCLA. 1995.

Independent Consulting

1997 Biodiversity Consultant. DHV-Consultants, Netherlands. World Bank-Funded Socio-
Economic-Ecological Zoning of the State of Rondonia, Brazil.

- Designed and directed a statewide geo-referenced field survey of stingless bees and euglossine bees involving determination of the impact of deforestation on species diversity.

- Worked closely with other fauna research teams in presentation of results to state government officials and World Bank representatives.

- Conducted extensive field and laboratory work, produced maps with ArcView, and managed large database using MSAccess.
Additional Research and Training

1991  Advanced Brazilian Language and Culture. Federal University of Pernambuco, Recife, Brazil.


1987-1992  Research Assistant. Dr. Orley R. Taylor, Professor of Entomology, University of Kansas. Collaborated closely with Dr. Taylor to devise and conduct bee genetics research with Africanized bees in Mexico and European bees in Kansas. Involved laboratory and fieldwork.


Teaching Experience

2001-present  Department of Geography and the Environmental Studies Program, University of Kansas.

  * **Borders and Climates**: NSF-C-Change IGERT Program
  * **The Global Environment I and II**: Freshman experience course
  * **Moral Geographies of Environment and Development**: graduate seminar
  * **Principles of Environmental Studies**: introductory environmental studies
  * **Environment, Culture, and Society**: introductory environmental studies/geography
  * **Middle America**: upper division regional geography
  * **World Regional Geography**: introductory geography
  * **Environment and Development**: graduate seminar
  * **Tropical deforestation in Latin America**: regional environmental studies seminar
  * **Environmental Issues of Latin America**: regional environmental studies seminar
  * **Geography of Brazil**: upper division/graduate regional geography
  * **Environmental Conservation**: upper division undergraduate seminar

1999-2001  Lecturer. Department of Geography, UCLA:

  * **People and the Earth’s Ecosystems**: One of the geography department’s core classes for majors and a general life science credit course taken widely by first and second year undergraduates. Course enrollment 200 students.
  * **Forest Ecosystems**: Upper division class required for biogeography specialization. Course covers principles of forest ecology and geography. Emphasis on role of disturbance in forest dynamics in addition to survey of ideas of nature that have guided human relationships with forests.
Mexico, Central America, and the Caribbean. Upper division regional geography class. Themes include physical geography, culture, US intervention, tourism, trade, environment, development, and conservation.

1999-2001 Adjunct Professor. Department of Geography, Santa Monica College:

Introductory Human Geography and Physical Geography.


1991 Graduate Teaching Assistant. Department of Spanish and Portuguese, University of Kansas. One semester.

Languages

Portuguese, fluent; Spanish, proficient

Service

University of Kansas

Undergraduate program committees in Geography, Environmental Studies, and Latin American Studies; Faculty Affairs in Geography and Environmental Studies; Curriculum and Outreach for Geography; IGERT Faculty Member; Graduation Procession Faculty Marshall and University Associate Marshall; College Committee on Sabbaticals and Leaves, 2007-2009; Member of the University Sustainability Advisory Board, 2009-present; Chair, Center for Global and International Studies Executive Committee, 2009-present; Chair, Latin American Studies Executive Committee, 2010; Strategic Planning University Steering Committee Member, 2010-2011; Teaching Excellence Advisory Member, 2010-present.

Journal Reviewer


Association of American Geographers


Latin American Studies Association

Conference of Latin Americanist Geographers

Board member, 2009-2011.

Brazilian Studies Association

Co-organizer of sessions on Commodity Geographies of Brazil, BRASA, New Orleans, 2008.

IIE Fulbright

Member of the National Screening Committee for MA and PhD project proposals to Brazil, 2008 and 2010.

Teaching and Advising


Invited participant in sessions to advise undergraduate and graduate students in writing grants such as Fulbrights to study abroad. Office of Special Fellowships, UCLA. 1998-2000.

Professional Affiliations

Association of American Geographers
Brazilian Studies Association
Conference of Latin Americanist Geographers
Latin American Studies Association

Graduate Advisees (and current situation)

Tim Brock, M.A. (University of Kentucky Ph.D. student)
David McDermott, M.A. (Haskell Indian Nations University)
Audrey Fusco, M.A. (Sanibal-Captiva Foundation)
Vanessa Carneiro, M.A. (International Finance Corporation, São Paulo)
Benjamin Coles, M.A. (University of Leicester)
Mauricio Herrera, Ph.D. (University of Costa Rica)
Heather Putnam, Ph.D. (current advisee)
Lisa Rausch, M.A., Ph.D. (current advisee)
Vijay Barve, Ph.D. (current advisee)
Matthew Koeppe, Ph.D. (NASA)
MARK E. JAKUBAUASKAS

Kansas Biological Survey
116 Higuchi Hall, 2101 Constant Avenue
University of Kansas
Lawrence, Kansas 66047-3759

Office:(785) 864-1508
Fax: (785) 864-1534
Home: (785) 842-9754
Email: mjakub@ku.edu

POSITIONS HELD
2004-present Associate Research Professor, Kansas Biological Survey, University of Kansas.
2005-present Courtesy Associate Professor, Environmental Studies Program, University of Kansas.
2004-present Courtesy Associate Professor, Department of Geography, University of Kansas.
1998-2004: Assistant Research Professor Kansas Biological Survey, University of Kansas.
1998-2004: Courtesy Assistant Professor, Department of Geography, University of Kansas.
1988-1991: Graduate Teaching Assistant, Department of Geography, University of Kansas.

EDUCATION
1994 PhD (Honors), University of Kansas (Geography).
Dissertation: Modeling Coniferous Forest Succession in Yellowstone National Park Through Integration of Landsat Thematic Mapper and GIS Data.
1988 M.A. Indiana State University (Physical Geography).
1986 B.A. State University of New York at Geneseo, Physical Geography (minor in geology).

FUNDED GRANTS AND CONTRACTS
2012-2014 Sediment Core Analysis for Understanding Reservoir History. PIs Jakubauskas and deNoyelles. Kansas Water Resources Institute Martinko. $15,000
2011-2012 Bathymetric surveys of Kansas reservoirs containing public water supply storage. PIs Jakubauskas, deNoyelles. Kansas Water Office. $155,000
2010-2011 Bathymetric surveys of Kansas reservoirs containing public water supply storage. PIs Jakubauskas, deNoyelles. Kansas Water Office. $160,000
2009-2010 Determining the utility and adaptability of remote sensing in monitoring and assessing reservoir eutrophication and turbidity for TMDL assessments. PIs Huggins, Jakubauskas, and D. Baker. US Environmental Protection Agency Region 7, EPA-R7WWPD-08-005. $75,000
2009-2010 Bathymetric surveys of Kansas reservoirs containing public water supply storage. PIs Jakubauskas, deNoyelles, Martinko, and Campbell. Kansas Water Office. $155,000
2007-2008 Bathymetric surveys of Kansas reservoirs containing public water supply storage. PIs Jakubauskas, deNoyelles, Martinko, and Campbell. Kansas Water Office. $165,000
<table>
<thead>
<tr>
<th>Year</th>
<th>Project Description</th>
<th>PI(s)</th>
<th>Funding Agency</th>
<th>Award Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-2007</td>
<td>Bathymetric surveys of Kansas reservoirs containing public water supply storage. PIs Jakubauskas, deNoyelles, Martinko, and Dzialowski. Kansas Water Office.</td>
<td>$60,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006-2007</td>
<td>Development of predictive models for the management of taste and odor events in Kansas reservoirs. PIs Huggins, Dzialowski, deNoyelles, and Jakubauskas. Kansas Water Office.</td>
<td>$100,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005-2007</td>
<td>Remote sensing research for detection and identification of abandoned oilfield features. PIs Jakubauskas and Martinko. Kansas Corporation Commission.</td>
<td>$50,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>Montane meadow mapping using satellite imagery. Iowa State University (passthrough funds from The Nature Conservancy).</td>
<td>$1000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1996-1997  Modeling regional-scale vegetation dynamics through integration of mesonet and remotely sensed data. $ 243,000 (3 year total); Subproposal within research cluster Research on the Fluxes of Water and Energy at the Land Surface National Aeronautics and Space Administration/ Oklahoma EPSCoR. Co-Investigator with nine other scientists at University of Oklahoma. $ 3.0 million (3 year total).


1991-1994  Spectral-ecological modeling of forest successional dynamics using Landsat Thematic Mapper Data and geographic information systems. NASA Graduate Fellowship in Global Climate Change Research. $ 66,000.


PUBLICATIONS - Refereed:


PUBLICATIONS – Refereed (In press, in review, or submitted):


PUBLICATIONS - Proceedings:


**PUBLICATIONS - Whitepapers**


**PUBLICATIONS - Magazine Articles, Book Chapters, and Other Non-Refereed:**


**PUBLICATIONS - Technical Reports**

*Not individually listed: Over 50 bathymetric and sediment survey reports prepared for Kansas lakes and reservoirs surveyed under contract with the Kansas Water Office. A list of these reports is available.*


**PUBLICATIONS – Abstracts**


**HONORS AND AWARDS**

Junior Faculty Research Award, OU Research Council, 1995
NASA Global Climate Change Research Fellowship, 1991-1994
Research Assistantship, Kansas Applied Remote Sensing Program, University of Kansas
Teaching Assistantship, Department of Geography, University of Kansas
Teaching Assistantship, Department of Geography, Indiana State University.

COURSES TAUGHT

University of Kansas, 2000-2012: EVRN 410, Geospatial Techniques in Environmental Studies
EVRN 510, Advanced Geospatial Techniques in Environmental Studies
EVRN 420, Geospatial Techniques in Environmental Studies
Geog. 358, Intro. to Geographic Information Systems
Geog. 758, Advanced Geographic Information Systems
Geog. 536, Landscape Ecology
Geog. 980, Seminar in Professional Development
Geog. 980, Seminar in Hypertemporal Image Analysis

Geog. 4453/5453, Geographic Information Systems.
Geog. 4283/5283, Biogeography.
Geog. 6210, Advanced Field Techniques
Geog. 5990, Seminar in Landscape Ecology
Geog. 6272, Introduction to Graduate Studies

Geog. 726, Remote Sensing II, Image Processing Lab.
Geog. 105, Introductory Physical Geography Lab.

INVITED PRESENTATIONS

Department of Geography, Mansfield University, PA; Department of Geography and Geology, Bloomsburg University, Bloomsburg, PA; Department of Geography, University of Delaware; University of Wyoming/National Park Service Research Station; Los Alamos National Laboratories, Environmental Sciences Division; New York Zoological Society, New York, New York; Kansas Association of Mappers; Department of Geography, University of Nebraska-Lincoln; Department of Geography, State University of New York at Geneseo;

SERVICE - Professional:

GRADUATE STUDENTS:
University of Kansas: Ryan Callihan (MA, in progress); L. Monika Moskal (PhD, 2005), Matthew Dunbar (MA, 2005), Willem Helms (MA, 2003); University of Oklahoma: Jessie Robinson (MA, 2002).
Appendix E

PSM-EA External Advisory Board Members, 2012-2013
**KU Professional Science Masters – Environmental Assessment**  
**2012-2013 External Advisory Board**

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suzanne Bailey</td>
<td>Assistant Vice President</td>
<td>Marshall Miller &amp; Associates, Inc.</td>
</tr>
<tr>
<td>Betsy Betros</td>
<td>Interim Director</td>
<td>Johnson County Environmental Dept</td>
</tr>
<tr>
<td>Michael Denning</td>
<td>Dir. Professional Military Graduate Education</td>
<td>University of Kansas</td>
</tr>
<tr>
<td>Ryan Hrabe</td>
<td>Biologist</td>
<td>Ecology &amp; Environment, Inc</td>
</tr>
<tr>
<td>David Kocour</td>
<td>Transportation/Water Department Manager</td>
<td>URS Engineering</td>
</tr>
<tr>
<td>Earl Lewis</td>
<td>Assistant Director</td>
<td>Kansas Water Office</td>
</tr>
<tr>
<td>Frank Norman</td>
<td>Principal</td>
<td>Norman Ecological Consulting, LLC</td>
</tr>
<tr>
<td>Elizabeth Quinlan</td>
<td>Project Scientist, Water Division</td>
<td>Black &amp; Veatch</td>
</tr>
<tr>
<td>Tracie Ragland</td>
<td>Environmental Scientist</td>
<td>Terracon Companies, Inc.</td>
</tr>
<tr>
<td>Andrea Repinsky</td>
<td>Planner</td>
<td>Mid-America Regional Council</td>
</tr>
<tr>
<td>Jeffery Robichaud</td>
<td>Deputy Director, Env. Services Division</td>
<td>USEPA Region 7</td>
</tr>
<tr>
<td>Randall Root</td>
<td>Sr. Project Manager</td>
<td>Burns &amp; McDonnell</td>
</tr>
<tr>
<td>Elizabeth Smith</td>
<td>Environmental Scientist</td>
<td>Kansas Dept. Health and Environment</td>
</tr>
<tr>
<td>Anastasia Welch</td>
<td>Associate Principal</td>
<td>Aquaterra Environmental Solutions</td>
</tr>
</tbody>
</table>
Appendix F

The Professional Science Masters degree from a national academic perspective
Professional Science Master’s Programs Merit Wider Support

Rita R. Colwell

The United States faces growing global competition in the development of innovative products and services, a challenge much like a “silent Sputnik” to which the nation must pay more attention (1). One component of the U.S. educational system that can help us meet that challenge is master’s level education in the natural sciences.

In most fields in the natural sciences, master’s degrees have long been viewed mainly as milestones en route to a doctorate, rather than destinations in their own right. But about a decade ago, foundations and universities began experimenting with new master’s programs that develop advanced scientific knowledge and professional skills such as communication, project management, and commercialization. Most of these innovative Professional Science Master’s (PSM) degree programs are interdisciplinary and provide hands-on learning through internships and team projects. They are not intended to displace traditional programs. Instead, they aim to engage students with professional goals and help them become scientists uniquely suited to the 21st-century workplace, equipped with a deeper and broader scientific knowledge than that acquired with a Bachelor of Science degree and the skills to apply it.

The experiment has yielded promising results. Beginning with seed money from the Alfred P. Sloan Foundation to establish individual PSM programs at existing institutions and an endowment from the W. M. Keck Foundation to establish the Keck Graduate Institute of Applied Life Sciences, the experiment has resulted in 128 PSM programs now under way at 64 universities in 23 states, producing about 600 graduates per year. (Examples of these PSM programs are listed in the table on the right.) The America COMPETES Act (Public Law 110-69) provides an opportunity for further growth by authorizing the National Science Foundation (NSF) to provide grants for the creation or expansion of up to 200 programs. With broader support from the community, these programs could engage and benefit far more students and employers, providing a powerful contribution to our nation’s competitiveness. That was the conclusion of a recent study from the National Research Council, for which I served as chair (2).

The report committee found that many stu-
udents who could have useful and interesting careers in the sciences shy away from graduate school, uncertain about both the length of study for the doctorate and the career outcomes. PSM degree programs, typically 2 years in length, offer a different path for these students, whose interests and talents might otherwise be lost to the scientific work force.

Indeed, the creation of PSM programs could provide the United States with a competitive advantage by both providing opportunities for more domestic students in graduate science and attracting international talent as well. PSM program data have already shown that these programs have attracted greater numbers of women than other graduate programs in similar fields; it is hoped that this can be extended to underrepresented minorities as well. Meanwhile, programs in areas such as bioinformatics have begun to attract large numbers of international students.

Those who follow the PSM path will likely find employers—whose workforce needs are evolving—eagerly awaiting them, our study found. Biotech companies, information technology firms, banks and financial companies, and government agencies have testified to their need for employees with the knowledge and skills these programs cultivate. And the salaries of those who hold master’s degrees in science and engineering have grown faster over the last 10 years than salaries of those with bachelor’s degrees or Ph.D.s.

Members of this new cadre of science-trained professionals become investment analysts, science and technology acquisition managers, and forensic scientists. They work in emerging fields such as business intelligence, which uses data mining and mathematical modeling to solve business problems, and service science, which seeks ways to increase industry productivity and efficiency in the rapidly growing service economy. Some PSM graduates can be predicted to emerge as leaders in industry, government, and nonprofits.

In these jobs for which they are so well qualified, PSM graduates will benefit both individual employers and our nation’s ability to compete in the global marketplace. The capacity to innovate depends not only on scientific discovery but also on the ability to translate new knowledge into products and services. This is where PSM graduates can have a major impact. To accomplish this on a broad scale—especially for expanding industries such as biotechnology, which increasingly are focused on production—current PSM programs need to be scaled up and new programs created, a challenge for the concerted action of government, universities, foundations, and employers.

The report recommends Congress take the lead by fully funding and expanding the PSM initiative it authorized at the NSF in the 2007 America COMPETES Act. Congress has now provided an initial $15 million at the NSF for the PSM through the American Recovery and Reinvestment Act, which became law in February. These funds are available through 30 September 2010. Congress has an opportunity to provide additional funding under the COMPETES Act authorization in the Fiscal Year 2010 Budget; after that, Congress will need to provide both new authorization and appropriation. This initiative should be expanded to include other federal science agencies.

Congress should also add scholarships for U.S. citizens who enroll in PSM programs. The typical cost of a program varies greatly, depending on the type of institution, and so far PSM students have had to fund their master’s education. This is unlike many Ph.D. students who receive support through fellowships and research and teaching assistantships. However, it is not unlike students in professional programs in law, business, public policy, or medicine, who see the cost of such education as an investment in themselves that will pay off in the long run. Scholarships will allow many more students, particularly those from less advantaged backgrounds, to participate in PSM programs and will expand the number of domestic students who continue in science at the graduate level.

In the meantime, many PSM programs are preparing to meet the educational needs of veterans who will benefit from the Post-9/11 Veterans Education Assistance Act, which became law in July 2008. States, which have had a historic role in both higher education and economic development, must also play a role. They should regard PSM programs as critical to producing a cadre of science professionals who can manage and grow science- and technology-based industries in their states and regions and make wise investments to support them. In several states—North Carolina, New York, and California, for example—state universities have established systemwide plans for PSM programs across their campuses to meet key economic needs.

Universities, in turn, should continue to support existing programs, to create new ones, and to ensure that curricula evolve to reflect scientific developments and workforce needs. PSM programs have a responsibility within this context to engage in ongoing evaluation that will provide feedback on both processes and outcomes. This information will allow for midcourse corrections to increase program effectiveness.

Employers must be key partners in these efforts. PSM programs need to establish employer advisory boards and work with them to develop and evolve curricula and to develop linkages to the workplace. Employers can additionally sponsor student team projects, provide mentoring and internship opportunities for students, and hire graduates who meet their personnel needs.

To be sure, there are challenges in the development of PSM programs. A case must be made that funds for PSM development are a wise investment, justifying the opportunity costs. Individual faculty members also need to support these programs. While some do, others view master’s level education only as an incidental step for doctoral students. Worse, they claim to be too busy to give it attention. With appropriate incentives—program resources, credit for program development in tenure review—surely, more faculty would participate in starting and sustaining these programs.

Professional organizations in the sciences have a role as well. These societies historically have focused on encouraging and supporting the work of a doctorate-educated work force, but many are now considering a broader role in advancing education. The professional societies should take master’s education under their wings—creating committees to foster master’s education, recognizing faculty who have led successful PSM programs, and serving as field-specific clearinghouses of information about the programs.

PSM programs can make a vital contribution to this century’s work force, which needs employees who can work well in teams and across disciplines (3). It is time for leaders in government, education, and industry to show similar teamwork in supporting these programs—an investment to yield a talented group of scientists with the skills our nation requires most to meet the global challenges of the 21st century.

References and Notes

3. The PSM has also been endorsed in reports by the National Science Board, the President’s Council of Advisors on Science and Technology, the Council on Competitiveness, the U.S. Chamber of Commerce, the Association of American Universities, the Council of Graduate Schools, and the National Governors Association [see Appendix I of the study report (2) for details].
Professional science degree may be 21st century MBA

O ne hundred years ago (in 1908), a group of higher educators launched a new professional master’s degree called the MBA. Their aim: to meet the anticipated needs of 20th century business, which would be characterized, they thought, not by product specialty but by bigness. Today, MBA programs graduate about 90,000 students per year and are considered to have provided a singular advantage to American business.

Will the Professional Science Master’s, the science-based professional degree created nine decades after the MBA, manage to meet the needs of 21st century private and public enterprises? That’s the view (and hope) of the directors of 134 PSM programs at 71 universities, their employer partners and the 2,500 math/science graduates now enrolled.

The PSM is intended for math and science graduates bent on careers at the intersection of science and management. In large public and private enterprises, PSMers serve as lab and project managers and/or work in close collaboration with specialists in finance, intellectual property or regulatory affairs. In smaller startups, they carry responsibilities in both science and management. And in the public sector, their value is just now beginning to be recognized.

Judging by the successful hiring record of graduates, PSMers appear to be getting jobs that need to be filled.

“It’s best to think about the PSM not as a step down from the Ph.D. but as a step up from the bachelor’s,” says Bogdan Vernescu, the founding president of the National Professional Science Master’s Association. Eugene Levy, Rice University provost, goes further: “The master’s degree will evolve to become the normal expectation of professional careers.”

The PSM is filling an educational void as well as an employment void. As late as 1995, fewer than 3 percent of all U.S. M.S. degrees were in the sciences. The M.S. in those fields, earlier a respected graduate-level degree, came to be thought of as a failed Ph.D. Meanwhile the master’s degree in engineering continued to be highly respected, in part because engineering was in closer touch with business and industry.

The PSM founders argue that if physics is typical (the American Physical Society estimates that only one in six physics bachelors eventually earns a Ph.D. in physics), then a potential market exists for science and math-trained professionals.

But what is “professional training in mathematics and science” if not preparation for a research career? The PSM needed not just foundation support to launch the new degree (provided by the Alfred P. Sloan Foundation in New York City and the W.M. Keck Foundation in Los Angeles), but a change in presumptions about who will do science and why.

From 1997 to 2002 some 20 science master’s programs were established (the term PSM came later), providing an initial proof of concept. University faculty and deans engaged local employers in identifying future employment opportunities for master’s level science and mathematics graduates. Students (especially women) were attracted by the curriculum and the relatively short two years it would take to become professionally trained. And faculty found the students academically strong.

The heart of the PSM is the combination of graduate-level science and/or mathematics, often in a newly emerging discipline (such as bioinformatics) or at the intersection of two or more traditional ones. Absent a thesis, students enroll in short courses in business fundamentals, tech transfer, project management, intellectual property law, regulatory affairs, entrepreneurship, leadership and/or ethics—which, with training in communication (written and oral) and team building, constitute up to 30 percent of the students’ studies.

Rounding out their program is a required internship (in all but a few of the specialties) for enrollees not currently employed in a high-tech enterprise.

Today, the PSM is poised for expansion. In addition to campus-based programs, there are university system-wide adoptions in California, New York, Illinois, Massachusetts and North Texas as well as state-wide collaboratives in Oregon and Arizona. More are planned in Florida, New Mexico, Pennsylvania and Virginia.

All of these energetic initiatives have been launched without significant government support — so far. But this month, that will change. The National Science Foundation is rolling out a program for spending $15 million in economic stimulus funds for the PSM. The new Veterans Education Bill, which includes support for graduate education, will go into effect in August. State-level veterans offices are already eyeing the PSM (and pre-PSM certificates) as a natural way back into the workforce for technically trained officers.

Sheila Tobias has been a consultant with the Alfred P. Sloan Foundation on PSM development since 1997. Info at www.sciencemasters.com or www.npsma.org