

Professional Science Master's Degree Program In Geographic Information Science (GISc)

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	• Emerging Health Information Technologies, Inc.	
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	• New York City Department of Health and Mental Hygiene (DOHMH)	
	• Wildlife Conservation Society (WCS)	
	• CUNY Graduate Center Earth and Environmental Science Doctoral Program	
	• NOAA-CREST (National Oceanic and Atmospheric Administration Cooperative Center for Remote Sensing Science and Technology)	
	• Lehman College Master's of Public Health Program	
	• New York City Department of Environmental Protection (DEP)	

LETTER OF INTENT

PROFESSIONAL SCIENCE MASTER'S DEGREE PROGRAM IN GEOGRAPHIC INFORMATION SCIENCE (GISc)

GISc Program Abstract:

Lehman College's Department of Environmental, Geographic, and Geological Sciences (EGGS) proposes an inter-disciplinary Professional Science Master's degree program in Geographic Information Science (the PSM in GISc). The intent of the proposed PSM in GISc program is to prepare students to meet the demands and challenges of professional careers in the field of geospatial sciences, which has seen an exponential increase in the demand for highly qualified personnel in the fields of healthcare, environmental, and geospatial sciences, in recent years.

It will take full-time students four terms to complete the 39-credit program. In the first years we expect 10 students to join the program per year; we anticipate a gradual increase in this number thereafter.

GISc has become one of the major disciplines involved in analysis of environmental, health, and other societal concerns, and thus is poised to become an increasingly integral part of all scientific endeavors having a spatial component. GISc is a field of study encompassing spatial analysis, computer-assisted cartography, geostatistics, and exploration and interpretation of geographic data. We expect that the proposed interdisciplinary PSM in GISc, with emphasis on public health and environmental spatial sciences, will be highly attractive to professionals working in these fields who strive to optimize their qualifications.

The curriculum of the proposed PSM in GISc is comprised of key elements that include existing courses and one newly proposed course for a specialization track in Public Health and Environmental Spatial Sciences. This new comprehensive program will enable students to develop the necessary theoretical, programmatic, and applied skills in the general area of spatial analysis that are necessary to succeed in the present day field of public health and related industries.

I. PURPOSE AND GOALS

GISc has become one of the major disciplines involved in analysis of environmental, health, and other societal concerns, and thus is poised to become an increasingly integral part of all scientific endeavors having a spatial component. Geographic Information Science is a field of study encompassing spatial analysis, computer-assisted cartography, geostatistics, and exploration and interpretation of geographic data. The recent years have seen an exponential increase in the demand for highly qualified personnel in the fields of healthcare, environmental, and geospatial sciences. We expect that the proposed interdisciplinary PSM in GISc, with emphasis on public health and environmental spatial sciences, will be highly attractive to professionals working in these fields who strive to optimize their qualifications.

The intent of the proposed PSM in GISc program is to prepare students to meet the demands and challenges of professional careers in the multidisciplinary field of Geographic Information Science, while also serving as a potential for continuation of the educational pipeline from undergraduate to Master's and to advanced degrees beyond the Master's, including those available through the CUNY Graduate Center's Earth and Environmental Sciences Doctoral Program and other similar programs. The PSM in GISc program will offer opportunities for students to engage in real-world GISc project work, and faculty-student research collaboration. Partnerships established through Lehman's existing GISc Certificate program with organizations and agencies will be continued and amplified, permitting students to experience working with professionals in the field, and contributing in a meaningful way to solving complex urban, environmental, and health problems. These partnership organizations and institutions include the New York City Department of Environmental Protection; Montefiore Medical Center; the New York City Department of Health; New York Botanical Gardens; the Wildlife Conservation Society (the Bronx Zoo); the New York City Parks Department; several environmental consulting firms; non-profit environmental and community planning groups; and many other federal, state, and local governmental agencies.

Lehman College is ideally suited to host this program because

- Lehman's EGGs Dept. is adequately staffed with full-time faculty to teach all of the required core courses and the majority of the electives, and have already been doing so for several years;
- most of the required core courses are already part of the existing curriculum in the GISc program;
- all necessary facilities and equipment are already in place; and

the implementation of this program is perfectly in line with the strategic plan and mission of the department and the college (promotion of STEM fields).

A. Program Structure

The curriculum of the proposed PSM in GISc is comprised of key elements that include existing courses and one newly proposed course for a specialization track in Public Health and Environmental Spatial Sciences. This new comprehensive program will enable students to develop the necessary theoretical, programmatic, and applied skills in the general area of spatial analysis that are necessary to succeed in the present day field of public health and related industries.

The breadth required to achieve the necessary strength involves the construction of academic links across the span of the health sciences, environmental sciences, and geography at Lehman. In this way, the PSM-GISc program will have the inherent flexibility to adjust to the

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growing demands of Geographic Information Sciences leading to anticipated future tracks within the Professional Science Master's Program (e.g., expanded areas of remote sensing, environment and sustainability, urban planning, and applied geo-spatial analysis).

Lehman's existing graduate-level GISc courses in the EGGs Department and the Master's of Public Health will form the central components of the proposed Professional Science Master's program in GISc at Lehman. Faculty, research expertise, and laboratory space and equipment are already in place for the proposed PSM-GISc program at Lehman through the existing GISc Certificate program. The EGGs Dept. has established close relationships with the Lehman MPH program as well as with all the public health programs in the CUNY School of Public Health. We already share faculty between the departments/programs, cross-list a number of GISc courses, work collaboratively on research projects, place students in appropriate internships, and partner with the other programs in a number of other ways.

Another basis of support for this program is provided by the vibrant and nationally-regarded National Oceanic and Atmospheric Administration Cooperative Remote Sensing Science and Technology (NOAA-CREST) Center at CCNY and Lehman. This unique 20 million dollar center has already created a series of courses and a network of faculty all focused on environmental issues thus forming a strong platform for the proposed new Master's Program. NOAA-CREST is one of only five Educational Partnership Programs supported by NOAA in the United States and is therefore one of the premier Centers for remote sensing and climate in a major urban setting. Lehman College's EGGs Department is a full partner in NOAA-CREST. In addition to tuition support and stipends to under-represented minority students, NOAA-CREST offers students opportunities to collaborate within all NOAA-CREST partner institutions on research, presenting papers at national and international conferences, internships at NOAA headquarters and other NOAA cooperative centers, and working closely with mentors that are drawn from Lehman College, City College, University of Maryland, Hampton University, Columbia University, the University of Puerto Rico, and the NASA-Goddard Institute for Space Studies, among other NOAA-CREST partners. In addition, City College and Lehman have been working together for several years to encourage students to take courses across the spectrum of NOAA-CREST partnership colleges, and there have been several instances of successful course sharing, which directly benefits graduate students from our respective campuses by offering a wider range of courses that might not be fully enrolled by each campus separately. The resources of NOAA-CREST are considerable, and many of our prospective PSM-GISc students would have access to them. Additionally, NOAA-CREST serves as an educational "pipeline" for minority students who are under-served in the sciences, propelling them from undergraduate to graduate to doctoral level work, and thus the PSM-GIS program has the potential to be a valuable source of funded students for the Graduate Center's Earth and Environmental Sciences (EES) doctoral program. (See Letters of Support attached to the LOI, from both Reza Khanbilvardi, Director of NOAA-CREST, and Yehuda Klein, EO of the EES program at the GC.)

B. Program Purpose

In recent decades, increasing attention has been given to global change as it influences local areas, and to the integration of local area information into the global system framework. This confluence has been driven in part by the growing necessity for the intelligent management of natural resources, and for developing optimal approaches to spatial management issues, such as coastal processes, surface and groundwater hydrology, urban public policy, sustainable development, growth management of megacities, health and the built environment, and in all

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phases of environmental remediation and modeling. The key to the effective management of resources revolves around an ability to utilize modern imaging, mapping and data assessment techniques. The new PSM-GISc program is envisioned as an umbrella discipline that encompasses established fields such as environmental health, earth science, environmental and urban geography, geographic information science, and remote sensing. There is a critical need to elevate the Masters-level curriculum within the City University of New York to meet growing sustainability issues. The proposed structure draws together existing talent and resources to create the necessary links between the environmental sciences-public health-geography fields and established research areas, such as those developed under NOAA-CREST and the Urban GISc Laboratory at Lehman. Although students graduating with undergraduate degrees in earth and environmental science, geology, biology, chemistry, and other natural and social sciences, are well-grounded in the behavior of complex and dynamic systems, such as climate change, global warming, and resource management, there is a clear need for graduate work in the areas proposed for the PSM-GISc, areas that deal specifically with spatial analysis, modeling and mapping, geo-statistical evaluation of current and future conditions, and most importantly, the application of these skills in real-world industries like the field of Public Health.

It is increasingly evident that solutions to environmental, industrial, and governmental needs require a cross-disciplinary array of scientific and analytical skills. As a consequence, a growing number of institutions have put in place multi-disciplinary Geospatial Sciences Programs, such as *Geomatics* at the University of Florida, the *Master's of Geospatial Information Sciences (MSc)* at the University of Texas, the *Master's of Geographic Information Science (MGIS)* program at the University of Minnesota, and the *Master's of Science in Geographic Information Science* at Indiana University-Purdue University Indianapolis (IUPUI). Such programs are flexible, providing a robust level of general training, while allowing a wide array of specializations. The intent of the PSM is to combine rigorous science education with professional development and training, using a multidisciplinary approach. The proposed PSM in GISc will prepare students to take their place in the myriad firms and organizations that work with locational data while providing them with a solid technical expertise in a related and cross-disciplinary field, such as public health or urban sustainability planning.

This proposed PSM in GISc will be in keeping with the principles of the Council of Graduate Schools PSM Guidelines for the following reasons:

- Geographic Information Science is an important and cutting-edge science discipline. The overall science content of the coursework is anticipated to be between 75-90%, depending upon the value-added cluster selected as a concentration.
- The curriculum is interdisciplinary and multi-disciplinary combining with professional skills component with rigorous science training.
- The PSM is designed to prepare students for direct entry into the professional fields, such as public health, environmental management and planning, any other field requiring geospatial experts.
- It has a substantive professional experience as a required part of the curriculum.
- The value-added courses contribute substantially to the sectors of policy, ethics, planning, regulatory affairs, communication, and teamwork.

More detailed information on the growing workforce needs in the geospatial technology industries and relevant employment potential can be taken from the US Dept. of Labor Report under <http://www.doleta.gov/brg/Indprof/Geospatial.cfm>. The fact that Geospatial Technology fits into the High Growth Industry Profile is also confirmed by <http://www.nationalgeographic.com/foundation/pdf/GeospatialHighGrowthProfile.pdf>.

II. NEED AND JUSTIFICATION

Needs of Students

It has become crucial to train scientists who can perform research, analyses, and predictive modeling on the spatial aspects of environmental and health issues, while also being aware on a very practical level how this fits in with organizational and corporate mandates and standards, including an awareness of policy and ethics. This degree program will prepare students to do so and to enable them to take their place in industry, non-profit organizations, health care institutions, and governmental agencies, as well as in academia. Geographic Information Sciences is a growing and cutting edge field with numerous career possibilities and opportunities.

Since we started the GISc Certificate Program, it has attracted students from varied disciplines and backgrounds, including health sciences, biology, ecology, anthropology, sociology, urban planning, architecture, political science, and computer science, in addition to the traditional geography and environmental science majors. We anticipate that a wide variety of students will continue to be attracted to the PSM-GISc program, and we will continue to be able to draw on these diverse areas to increase the ranks of the students in the proposed program.

Needs of the College

The Lehman College mission specifically promotes the preparation of students to enable them to live and work in the global community through new interdisciplinary programs, a good example of which is the proposed PSM-GISc program. According to the Vision Statement, "The College's geographic information systems and numerous partnerships with schools, hospitals, social service and governmental agencies, small businesses, major corporations, and cultural and scientific institutions will contribute to the economic development of the region. Service learning and internship opportunities will be further developed to foster the engaged citizenship and commitment to public service embodied in its namesake, Herbert H. Lehman."

We anticipate that much of the work that our prospective graduate students and GISc faculty will engage in will be very supportive of the Lehman mission and vision statements, especially regarding the commitment to public service, active citizenship, and the betterment of the community and quality of life for all New Yorkers.

Needs of CUNY

Lehman College's EGGS Dept. has graduated over 20 students (undergraduate) from our 17-credit GISc Certificate Program since 2003 (approximately 40 additional students received the undergraduate or graduate level certificate without matriculation at Lehman). Many of these students wanted to continue on in a Master's degree program, but there is no such degree program at Lehman. In fact, there is no specialized Master's degree program in GISc offered on any CUNY campus, or anywhere in the NYC metropolitan region, although several colleges and universities offer general Geography Master's degrees, such as Hunter College and Rutgers University. The proposed PSM-GISc program would address the important need of enabling students to achieve a Master's degree in GIScience without having to leave the NYC region, thus allowing NYC organizations, agencies, and companies to benefit from the talent pool created by this program.

Needs of the Industry

Another focus of the PSM-GISc is to attract local professionals experiencing a need to modernize their skills in the area of spatial analysis and presenting mapped information in an

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appropriate format. A significant number of students in our existing GISc Certificate Program have been drawn from governmental agencies, medical institutions, and private environmental engineering firms who need to update and expand their knowledge base into the new area of spatial analysis. Many of these students, in particular the governmental agency employees, would strongly benefit from the opportunity to earn a PSM degree in this subject. An informal survey reveals that the majority of environmental consultants, engineering firms, health institutions, and government agencies have only limited internal resources in Geographic Information System Programming, overlaying GIS maps with satellite information, performing important statistical evaluations of mapped data or presenting information in an appropriate GIS format. Many smaller companies depend on commercially available routines, for example existing Autocad or related programs that are edited to display relevant information. Most engineering professionals and company administrators see the need to both upgrade the capability of existing staff, and to work with a college to create specialized programs for their applications.

Needs of the Community

Knowledge of GISc has become very important to community-based organizations, non-profit planning groups, and environmental and health advocacy groups, and has proven to be effective in presenting the community perspective on many local and wider-scope issues. Many community-based organizations have expressed an interest in gaining expertise in GISc in order to produce spatial analyses and presentation maps in-house, and also to acquire the skills necessary to accurately interpret and critique spatial data produced by others (e.g., consultants, governmental agencies). The analyses necessary for community-based research pertain to community health studies, urban planning and development problems, open space and preservation planning, environmental assessments, environmental justice evaluations, land use conflicts, zoning proposals, accessibility measurements, among many other community concerns that are eminently addressable through GISc. With GISc, the community has a more powerful voice and an increased ability to utilize quantitative and qualitative resources in order to participate more actively in the decision-making process. GISc can be an enormous benefit to the community: the proposed specialization track in environmental and health spatial sciences would help to address these important societal issues in a comprehensive and understandable way, while maximizing community involvement and participation.

Additionally, GISc has proven to be a powerful means of fostering community-university partnerships in order to deal with these significant issues in a collaborative manner. The proposed Professional Science Master's degree in GISc meets these needs at several levels. There is a baseline set of courses that are currently available at Lehman to allow individuals access at the entry level through advanced. There is also a proposed "value-added" tier of courses that will address the common needs of local agencies designed to upgrade skills and knowledge over that of the GISc courses. Therefore, the GISc program is geared to address a wide variety of needs across the spectrum of GISc education. Due to the relationship between the EGGs Department's Urban GISc Lab and NOAA-CREST, Lehman can provide an added resource: the downloading of real-time data from the new NOAA-CREST satellite receiving station. This unique capability is not duplicated in the greater New York area, and is an ideal add-on to the GIS capability of the PSM-GISc program. The PSM-GISc program is also an excellent source for professional development and the continuing education mandates of the Center for Worker Education and Masters Programs in Education. Lehman's GISc Lab has already worked closely with community groups (such as For a Better Bronx and the South Bronx

Environmental Justice Partnership); locally-based non-profit organizations (such as the Wave Hill Forestry Project, and the Wildlife Conservation Society); as well as local governmental institutions (Bronx Borough President's Office, Bronx Parks Dept., Bronx Overall Economic Development Corporation, NYC Dept. of Health), and major health institutions (Montefiore Medical Center, Albert Einstein College of Medicine, and New York Medical College) and we expect that these relationships will continue to expand with the implementation of the PSM-GISc program.

III. STUDENT INTEREST AND ENROLLMENT

A. Anticipated Student Body

Evidence for student interest in this area is clear. Lehman's existing GISc program, implemented in 2003, has awarded more than 20 certificates to undergraduate students, after students completed the 17-credit program (approximately 40 additional students received the undergraduate or graduate level certificate without matriculation at Lehman). Another pipeline for students to enter the PSM-GISc program is the new interdisciplinary Environmental Science major at in the EGGs Department in collaboration with the Departments of Biology, Chemistry, and Physics and Astronomy. These programs are inherently multi-disciplinary in their organizational structure and curriculum and provide a foundation for the proposed new Master's program, as well as potential students.

The EGGs Department at Lehman College has introduced GIS and remote sensing courses in the last several years that have attracted many students to GISc technology. The proposed PSM-GISc Master's degree program is a logical extension both from this standpoint and as an important advanced-degree area for NOAA-CREST students. And, as mentioned in the "Needs" section above, many of the students completing the GISc Certificate Program at Lehman would like to continue on in a Master's program in GISc, but are unable to do so due to lack of availability of such a program locally. There are also a number of environmental science-related programs at CUNY Community and Senior Colleges that make a possible pool of students for recruitment into the proposed program, as well as students from undergraduate degree programs in health sciences, biology, ecology, anthropology, sociology, political science, computer science, and other natural and social sciences, who currently form the preponderance of the student body in the GISc Certificate program.

Students are likely to be drawn from all CUNY campuses, other local area colleges in Rockland, Westchester, and nearby New York and New Jersey counties. In addition, we expect that a significant portion of the PSM students in the GISc Program will be returning mid-career professionals, whose jobs include working with spatial information and who need to update and expand their knowledge base to enable them to do so effectively, or to manage those who do. There is very little likelihood that the student body anticipated to enroll in Lehman's PSM-GISc program will overlap or conflict with any other existing CUNY graduate level program.

It is envisioned that the entering class may attract approximately 10 students initially, but with appropriate outreach support by the College, enrollment is projected to grow swiftly in the near future.

B. Projected Enrollment

Projected Enrollment in PSM-GISc at Lehman (full time students)

Projected Enrollment	Year 1	Year 2	Year 3	Year 4	Year 5
Number of Incoming Students	10	10	15	15	20
Projected Total Enrollment	10	19	24	28	33

These numbers are based on informal surveys of current and past GISc Certificate students at Lehman, and data from comparable Master's programs.

The percentage of attrition is estimated based on an informal survey of other four-year institutions, both public and private, currently offering a similar technical and professional master's degree programs in the New York City area. The attrition rates from these institutions ranged from seven to 12 percent. Based on the attrition rates of other institutions, an average attrition rate of approximately 10 percent was used in the above estimations.

We calculated projected total enrollment as follows:

		Example (Year 3)		
	Projected Total Enrollment _(Previous Year)	Projected Total Enrollment _(Year 2)		19
–	Attrition Number Incoming Students _(Previous Year)	–	Attrition Number Incoming Students _(Year 2)	– 1
–	Graduating Students _(Previous Year)	–	Graduating Students _(Year 2)	– 9
+	Number of Incoming Students _(Current Year)	+	Number of Incoming Students _(Year 3)	+ 15
=	Projected Total Enrollment _(Current Year)	=	Projected Total Enrollment _(Year 3)	= 24

C. Admission Requirements

In order to be accepted to the PSM-GISc program in the EGGS Department at Lehman College, students must:

- Possess a bachelor's degree (or its equivalent) from an accredited college or university;
- Have demonstrated the potential to successfully pursue graduate study – that is, have attained a minimum undergraduate grade average of B in geography or a closely allied field, and a minimum grade average of B in the undergraduate record as a whole;
- Submit two letters of recommendation;
- Submit an essay detailing their career objectives;
- If conditionally admitted, satisfy the degree requirements within three years.

IV. CURRICULUM

Graduate courses in Geographic Information Science will be offered through Lehman's EGGS Department. A Public Health and Environmental Spatial Sciences specialization track will be developed within the PSM-GISc. In the future, other specialization tracks may be developed, including ones focusing on environmental sustainability, urban planning, environmental technology, and applied geospatial analysis, in collaboration with other CUNY programs and campuses.

The Public Health and environmental spatial sciences specialization track proposed to be offered through Lehman's EGGS Department is outlined below. This track would entail a total of 39 credits: 21 credits of required core courses (including a 4-credit capstone experience of designing and implementing an applied project; and a 3-credit intensive professional experience course); 12 credits of GISc electives within the specialization track; and 6 additional credits of relevant coursework to be determined in consultation with an advisor, based on the student's stated interests and goals.

A. GISc and Public Health Specialization Track Description:

The proposed Public Health and Environmental Spatial Sciences Specialization Track at Lehman College would include core courses in Geographic Information Science (GISc), spatial analysis, and environmental modeling, and provide a concentration in geo-spatial sciences focusing on environmental and health issues. This focus would enable the integration of geo-spatial sciences and real-world applications in environmental analysis, risk and hazard assessment, public health, epidemiology, urban planning, urban geography, demographics, sociology, political science, ecology, biogeography, anthropology and archaeology, and other social and natural sciences. The program would examine the public policy connections and implications of GISc modeling and spatial analysis, and provide a broad-based framework in GISc theory and applied science.

The required courses are listed below in Section IV B, and include Principles of GISc; Remote Sensing; Geostatistics and Spatial Analytical Concepts; Special Topics in GISc: Environmental Modeling; and a GISc Research Workshop course as a capstone experience. A 3-credit Professional Experience course is also required.

The possible courses in the Public Health specialization track include Environmental Health; Health Informatics; Health Equity and Social Justice; Globalization and International Health; Biostatistics in Public Health; Public Health Epidemiology; Ethics in Public Health; and Public Health Policy and Management. See Section IV B below for complete list of possible specialization elective courses.

Other GISc electives include Environmental Health and GISc; Natural Hazards and Risk Assessment; Demography and Population Geography with GISc; Biogeography and GISc; and Urban Geography and GISc. See Section IV B for the full list of possible courses, and Appendix 1 for more detailed course descriptions of core courses and electives.

B. Proposed Required and Elective Courses for PSM-GISc Public Health and Environmental Spatial Sciences Specialization Track

<u>Required Core Courses:</u>	<u>Credits/Hours</u>
GEP 505 Principles of GISc (*)	3/4
GEP 621 Remote Sensing (*)	4/6
GEP 630 Geostatistics and Spatial Analytical Concepts (*)	3/4
GEP 605 (650) Special Topics in GISc (Environmental Modeling) (*)	4/6
GEP 690 Workshop in GISc Research (*)	4/4
GEP 670 Internship in GISc/Professional Experience (*)	3/3
(GEP 670 currently is listed as 4 credits, and will be revised to permit a variable credit of 3 or 4 credits, which can be repeated up to 8 credits)	

Total Required Core Course Credits Needed **21**

Public Health Specialization Track Electives (12 credits):

- PHE 702 Environmental Health (^)
- PHE 708 Health Informatics (^)
- PHE 709 Health Equity and Social Justice (^)
- PHE 722 Globalization and International Health (^)
- PHE 600 Biostatistics in Public Health (^)
- PHE 606 Public Health Epidemiology (^)

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PHE 608 Ethics in Public Health (^)
PHE 701 Public Health Policy and Management (^)
PHE 715 Planning and Evaluation of Community-based Public Health Programs (^)
PHE 731 Community Participation and Advocacy (^)

Additional Possible Electives (Partial list, and can also include courses from specialization track, as above)(6 credits):

GEP 602 Biogeography and GISc (*)	4/5
GEP 620 Demography and Population Geography with GIS (*)	3/4
GEP 635 Natural Hazards and Risk Analysis (*)	3/4
GEP 640 Urban Geography and GISc (*)	3/4
GEP 660 Analytical Cartography and Scientific Visualization (*)	4/6
GEP 675 Field Surveying, GPS, and Data Acquisition Methods (*)	3/4

Total Elective Course Credits Needed **18**

TOTAL FOR PSM-GISc **39**

(*) = Existing Graduate Course in EGGS Dept.

(^) = Existing Graduate Course in MPH Program

(~) = Proposed New Graduate Course under development.

Five of the six required core courses are existing at Lehman, and are currently offered at least once per academic year. The one course that will have to be altered slightly is GEP 670, the 6-credit Professional Experience course, which will be modeled after the existing 4-credit GEP 670, Internship in GISc. There are no new courses that need to be developed to start this program. All suggested elective courses in the Public Health specialization track as well as in the EGGS Department also exist. See Appendix 1 for Existing Graduate Level GISc courses.

C. Proposed Student Schedule:

It is expected that a full-time student will be able to complete all the requirements for the degree within four terms. Part-time students would likely need 5 or 6 terms to complete the requirements, taking between 6 and 7 credits each term. In the final term of the program, the student will take the GISc Research course, which is the capstone course of the degree, and entails the design and implementation of a substantive and comprehensive GISc research project. In either the third or fourth terms, the student would take GEP 670, Internship in GISc/Professional Experience.

Example of a Student Schedule (Full-Time)

Fall		Spring		Fall		Spring	
Course	Credit	Course	Credit	Course	Credit	Course	Credit
GEP 505 Principles of GISc (core)	3	GEP 621 Remote Sensing (core)	4	Spec. Topics GISc (Adv.) GEP 605 (core)	4	GISc Research GEP 690 (core)	4
PHE 702 Environmental Health (specialization track elective)	3	GEP 630 Geostatistics (core)	3	PHE 708 Health Informatics (specialization track elective)	3	PHE 608 Ethics in Public Health (specialization track elective)	3
GEP 620 Demography and Population Geography with GISc (elective)	3	PHE 722 Globalization and International Health (specialization track elective)	3	PHE 701 Public Health Policy and Management (specialization track elective)	3	GEP 670 Internship / Professional Experience	3
Total for Term #1	9	Total for Term #2	10	Total for Term #3	10	Total for Term #4	10

TOTAL CREDITS FOR PSM-GISc PROGRAM = 39

D. Residency Requirements and Transfer Credits

Graduate students in the GISc program at Lehman must complete as matriculated students at Lehman at least half of the total graduate credits required to complete their program, OR 18 credits, whichever is greater. Six (6) credits of the residency requirement may be taken as permit classes at other CUNY colleges offering appropriate master's-level courses.

Courses taken at other institutions can be applied to fulfill the GISc Master's degree requirements in the first term or two of attendance at Lehman as a matriculated student. Grades of B or better are required in order for courses to be eligible for transfer, and are subject to the approval of the student's graduate advisor at Lehman, and must also be approved by the Office of Graduate Studies. With appropriate permission, matriculated graduate students may apply as transfer credit towards their master's program a total of 12 credits of graduate courses completed prior to matriculation in the GISc program. Within the total of 12 credits may be included: courses applied toward a previously awarded graduate degree at Lehman or elsewhere (maximum of six credits); courses taken at Lehman College in a nonmatriculated status; and courses taken at other colleges where no degree has been awarded. See the Lehman College Graduate Bulletin for additional limitations regarding transfer credits.

V. FACULTY

A. Existing Faculty

As of spring 2011, the EGGS Department has four tenured or tenure-track professors qualified to teach in the GISc program: Prof. Juliana Maantay, the Director of Lehman's GISc Program; Prof. Stefan Becker; Prof. Yuri Gorokhovich; and Prof. Andrew Maroko. There are also two new faculty hires, who are specialists in GISc and Health, and are scheduled to start in Fall 2011 – one within the EGGS Dept. and one within the MPH Program, bringing the faculty for the PSM-GISc Program up to 6 full-time tenured or tenure-track faculty. EGGS also has a full-time Lab Technician who maintains the GISc Lab and works closely with the faculty in developing and updating lab exercises. The full-time faculty members and staff will be able to teach all the required courses and electives. See Appendix 2 for biosketches of full-time GISc faculty. Given that all courses do already exist, faculty will not be impacted or pulled away from established programs to teach new courses.

B. Proposed Administrative Structure:

The GISc Program will be administered by a coordinating committee, consisting of participating faculty and the GISc program director. The committee will oversee advisement, program development and recruitment. The GISc Program Director will be responsible for the day to day administration of the program.

C. External Advisory Committee

It is important to insure that the educational goals and the curriculum of the PSM in GISc keep pace with the demands of industry and government. To this end an Advisory Committee will be created with representatives from industry, ESRI (the preeminent GIS company and industry standard), and local government agencies, not-for-profits, and other relevant institutions, in conjunction with the GISc Coordinating Committee. This group will also help to direct outreach to local industry and government to promote the objectives of the GISc program and help place students in appropriate venues for their professional experience. The external advisory committee, made up initially of industry experts and individuals in the fields of GISc and public health, will be augmented with appropriate members when new specialization tracks are added.

VI. COST AND REVENUE ASSESSMENT

The proposed curriculum for the PSM-GISc with the Public Health specialization track is based almost entirely on existing courses currently being offered. These courses currently are run with excess capacity, and it is anticipated that the additional students enrolled in the PSM-GISc program will not necessitate the addition of extra sections of these classes and will not impact the ability of full-time faculty to teach in the already established programs.

The proposed PSM-GISc program also does not require new laboratories or facilities. The existing GISc Lab in the EGGS Department is a state-of-the-art facility, and will not require any significant upgrading for the foreseeable future. There are currently 24 workstations in the GISc Lab, and generally at this time our lab sections contain about 14 – 17 students. EGGS Department currently has a full-time laboratory technician, and this will be adequate to accommodate the additional enrollment due to the PSM-GISc program. Within the next few

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years, the PSM-GISc program will relocate to the new environmentally sustainable Science Building currently being constructed on the Lehman College campus.

The administrative costs for the proposed program will be minimal since the program will make use of existing Lehman College administrative structure, including the existing support and secretarial staff, as well as the existing GISc Program Director. There will be a negligible impact on library resources due to the GISc program. The only quantifiable expenditures associated with the implementation of the program will be costs for advertizing (websites such as /www.sciencemasters.com, brochures, posters etc).

Projected Expenditures for the PSM-GISc

First Year: Advertising	\$2,000	
Second Year: Advertising	\$2,000	
Third Year: Advertising	\$2,000	
Fourth Year: Advertising	\$2,000	
Fifth Year: Advertising	\$2,000	
Total Expenditures 5 years		\$10,000

The projected revenues are based on the figure of \$270 per graduate credit and the fact that students have to take approximately 20 credits per year. We expect that the PSM-GISc will be self-sustaining within its first year.

Projected Revenues for the PSM-GISc

First Year: 10 students @ \$270 per credit for 20 credits	\$54,000
Second Year: 19 students @ \$270 per credit for 20 credits	\$102,600
Third Year: 24 students @ \$270 per credit for 20 credits	\$129,600
Fourth Year: 28 students @ \$270 per credit for 20 credits	\$151,200
Fifth Year: 33 students @ \$270 per credit for 20 credits	\$178,200
Total Revenues 5 years	\$615,600

APPENDIX 1

Existing Graduate GISc Courses at Lehman College EGGS Dept.

Required Courses for PSM-GISc:

GEP 505: Principles of Geographic Information Science

(3 credits, 4 hours)

Course Description:

The use of Geographic Information Systems (GIS) in the teaching of Social, Earth and Life Sciences. Demographic Studies and Graphic Presentation of Demographic Analyses. The use of modern mapping techniques in studies of Earth Environment.

GEP 605 (650): Special Projects in GISc: Environmental Analysis and Modeling with GISc

(4 credits, 6 hours)

Course Description:

Use of Geographic Information Systems for conducting research and spatial analyses in the natural and social sciences. The advanced use of computer mapping and spatial analysis technologies for studying the physical and human components of the Earth environment.

GEP 621: Principles and Applications in Remote Sensing

(4 credits, 6 hours)

Course Description:

In this course, students are taught the fundamental concepts and principles of electromagnetic theory in remote sensing, becoming familiar with the characteristics, capabilities, and limitations of past, current, and planned future remote sensing systems, and develop practical skills in interpreting aerial photographs, satellite optical remote sensing data, and thermal and radar imagery. Students will also be exposed to a wide variety of applications in environmental mapping and monitoring, natural resources management, urban and regional planning, and global change research. Weekly assignments will be provided to develop skills in interpreting different types of images. A term project will be required to make use of remotely sensed data and digital image processing capabilities in one particular area of application.

GEP 630: Geostatistics and Spatial Analytical Concepts

(3 credits, 4 hours)

Course Description:

Explores the emerging fields of geostatistics and spatial analysis. Various quantitative techniques will be studied and applied to real-world geographic problems. Exploratory spatial data analysis (ESDA) will be done within multiple GIS packages such as ArcGIS and GeoDa. Traditional statistics (e.g. incidence ratio, correlation, regression) as well as geo-statistics such as spatially-lagged regression, spatial error model, and geographically weighted regression (GWR) will be performed within various packages including SPSS, GWRIII, GeoDa, ArcGIS, [R], and Excel.

GEP 690: Workshop in Geographic Information Science Research

(4 credits, 4 hours – may be taken for a total of 8 credits)

Course Description:

An advanced examination of mapping and of new computer-aided technologies in the natural and social sciences, including research design and methodology and designing and conducting an independent GIS research project, conforming to generally acceptable professional geographical practices and techniques, under the supervision of faculty.

Possible Elective Courses for PSM-GISc:

GEP 602: Biogeography and GISc

(4 credits, 5 hours)

Course Description:

The methods and techniques used to examine the past and current distribution of organisms, in the context of geophysical, evolutionary, and ecological processes. Study of the geographic ranges of living organisms and discussion of numerous relevant topics. Lab work will provide students with hands-on experience using GISc to explore such concepts as species distribution, island biogeography, and community fragmentation.

GEP 620: Demography and Population Geography w/GISc

(3 credits, 4 hours)

Course Description:

The world's population in the context of geography and demography. The theoretical framework, defined by the fields of population geography and demography, will be studied and explored qualitatively and quantitatively. Data sources and acquisition, population metrics (growth, change distribution, and composition), population and food supply, mortality, fertility, and migration. Lab work will provide students with hands-on experience using GISc to explore demographic concepts.

GEP 632: Environmental Health and GISc

(4 credits, 5 hours)

Course Description:

This course explores the field of environmental health, especially focusing on spatial factors, medical geography, and the use of Geographic Information Science (GISc) to analyze relevant relationships between environmental impacts, diseases, demographics, socio-economic conditions, and the implications on public health and policy. Topics include environmental epidemiology, environmental toxicology, environmental justice, environmental policy, hazardous substances, air and water quality, food safety, global warming, population pressures, solid waste, occupational health, and risk assessment, as related to environmental health. Lab work uses GISc to examine and analyze environmental health, population, and built environment data for planning and research.

GEP 635: Natural Hazards and Risk Analysis

(4 credits, 5 hours)

Course Description:

Fundamentals of the natural hazards and disasters origin; physical and social implications; methods of quantitative and qualitative analysis; elements of geographic, geological, social and political analysis applied to risk estimation and mitigation and management measures. Use of

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Geographic Information Systems (GIS) tools and analytical techniques in lab exercises and assignments.

GEP 640: Urban Geography and GISc

(3 credits, 4 hours)

Course Description:

This course covers the contribution of geographical concepts and methods to an understanding of contemporary and future urban problems. It applies the use of GISc to the study of the internal structure of cities and urban systems, including city dynamics, classic and postmodern models, central place theory, urban migration and mobility, race, ethnicity, and gender, urban migration, poverty, industrial and post-industrial urban societies, residential segregation, land use change, gentrification, urban and suburban sprawl, housing, urban environmental issues, and regional planning. Lab work involves using GISc to explore the form and function of urban areas, and to solve critical urban problems using spatial analysis.

GEP 670: Seminar and Internship Program in Geography

(10 field, 3 hours, 4 credits)

Course Description:

Current issues in Geographic Information Science (GISc), with weekly work as an intern in one of various governmental, non-profit, academic, or consulting organizations. Minimum 150 hours of GISc-related project work. This course may be repeated for a total of 8 credits.

GEP 675: Field Surveying, GPS, and Data Acquisition Methods

(3 credits, 4 hours)

Course Description:

The techniques and science behind field methods commonly used for the acquisition and creation of geo-spatial data. Various techniques for data capture as well as processing and analyzing the data within a geographic information system (GIS). Labs will focus on the hardware and software needed for data creation, the integration of this information into a coherent GIS, and basic concepts of analysis including point-pattern analysis. Students will use GPS devices, mobile GIS, workstation GIS, as well as data from other sources including satellite and airborne remotely sensed data.

Public Health Specialization Track Elective (all courses are existing in the MPH program):

PHE 702 Environmental Health (^)

(3 hours, 3 credits)

Course Description:

Impact of human activities on environmental quality and human health; effect of environment on health and disease; examination of ecological principles, environmental health assessment, health policy/law and environmental justice; human population dynamics; and types and sources of pollutants and approaches to prevention and control. Environmental disease monitoring and health risk assessment are examined using GISc.

PHE 708 Health Informatics (^)

(3 hours, 3 credits)

Course Description:

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Principles and concepts of informatics; access to key epidemiological databases; research and information retrieval sources; database analysis and design; resource evaluation, management, decision-making, and planning; legal and ethical issues; and the application of computer information systems to public health issues.

PHE 709 Health Equity and Social Justice (^)

(3 hours, 3 credits)

Course Description:

Analysis of health disparities and exploration of social, economic, political, and historical determinants of health, including unequal access and treatment by race and ethnicity, patterns of immigration, cultural bases of health, strategies for communicating with diverse populations, and interventions for reducing and eliminating ethnic and racial health disparities from an ethics and public policy perspective.

PHE 722 Globalization and International Health (^)

(3 hours, 3 credits)

Course Description:

Epidemiological aspects of major global public health problems. Focus on principles, basic statistical analysis, public health surveillance, field investigation, and surveys and sampling. Governmental responses to epidemics, disasters, and outbreaks.

PHE 600 Biostatistics in Public Health (^)

(3 hours, 3 credits)

Course Description:

Application and interpretation of basic descriptive and inferential statistical methods in the analysis of public health data.

PHE 606 Public Health Epidemiology (^)

(3 hours, 3 credits)

Course Description:

Identification, analysis, interpretation, and presentation of epidemiological data for improving the public health of communities. Emphasizes practical public health applications.

PHE 608 Ethics in Public Health (^)

(3 hours, 3 credits)

Course Description:

Ethical principles, values, and controversies in public health. Historical development of public health professional and ethical issues and current topics in the field.

PHE 701 Public Health Policy and Management (^)

(3 hours, 3 credits)

Course Description:

Theoretical concepts, practice, and implementation of public health programs in organized settings; external environment analysis of government structure, laws, and regulations, private sector managed care, and collaborative academic-community partnerships; and examination of internal organizational functions.

PHE 715 Planning and Evaluation of Community-based Public Health Programs (^)

(3 hours, 3 credits)

Course Description:

Fundamental approaches and methods for planning and evaluating public health programs. Application of theory and the empirical literature as a means of developing skills in evidence-based public health practice.

PHE 731 Community Participation and Advocacy (^)

(3 hours, 3 credits)

Course Description:

Role of advocacy in advancing public health, including techniques and strategies for organizing, educating, and effecting change; identifying common needs and interests, community participation, collaboration, and coalition-building; analysis of political environments and proposed legislation.

APPENDIX 2

Bio Sketches of Full-Time GISc Faculty at Lehman College's EGGS Dept.

Juliana Maantay

Dr. Juliana Maantay is a professor of urban and environmental geography at Lehman College, City University of New York, and director of Lehman's Geographical Information Science (GISc) Program, which she designed and established. She also is a faculty member in the Earth and Environmental Sciences Ph.D. program at the CUNY Graduate Center; the doctoral program (DrPH) in Public Health at the CUNY School of Public Health/CUNY Graduate Center; the Master of Public Health Program at Lehman; and a research scientist with NOAA-CREST, the National Oceanic and Atmospheric Administration Center of Remote Sensing Science and Technology, at City College.

Dr. Maantay has over 20 years experience as an urban and environmental planner and policy analyst with governmental agencies, nonprofit organizations, and private sector environmental and planning firms, and has been active in environmental justice research and advocacy for more than 15 years. She was the Director of the Center for a Sustainable Urban Environment at Hostos Community College, CUNY, where she developed and conducted a comprehensive GIS analysis of environment and health in the Bronx, a community-university partnership program of the United States Environmental Protection Agency. Her research on environmental health justice and related topics has been published in leading journals, including the *American Journal of Public Health*, *Environmental Health Perspectives*, *Health and Place*, *Urban Geography*, *Applied Geography*, *Cartography and GIScience*, and the *Journal of Law, Medicine, and Ethics*. Her award-winning book, *GIS for the Urban Environment*, was published in 2006 by ESRI Press (Environmental Systems Research Institute), and has remained on the Top 10 list of GISc books on Amazon.com since it was published. The book is currently specified for urban planning, public health, and geography courses in universities throughout the world. The book *Geospatial Analysis of Environmental Health*, which she co-authored with Dr. Sara McLafferty, was published in 2011 by Springer-Verlag.

Maantay's major research interests include the spatial analysis of health disparities and environmental health justice, and the use of participatory GISc for community-based organizations. She is a co-PI of the South Bronx Environmental Justice Partnership, with major funding from the NIEHS. Dr. Maantay serves on the Environmental Protection Agency's National Environmental Justice Advisory Council's Work Group in developing a nationally consistent screening method for environmental health justice communities, in the capacity of Geographic Information Science specialist. She has been invited to present her research at the National Research Council/National Academy of Sciences, the New York Academy of Sciences, the New York Academy of Medicine, National Institute of Environmental Health Sciences, the United Nations, NOAA, NASA, and numerous universities and public agencies.

Maantay has designed curricula for and taught courses in GISc; mapping science; cartography; environmental health and GIS; spatial analysis; urban planning with GIS; environmental geography; environmental modeling with GISc; GISc research methods; urban geography and GISc; and GISc for earth and environmental sciences. She has taught undergraduates, graduates, and doctoral students at Lehman, the Graduate Center, Hunter College, Hostos Community College, and Pratt Institute, and supervises the GISc Internship

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Program at Lehman. She holds an M. Phil. and a Ph.D. in urban environmental geography from Rutgers University, a Master of Urban Planning from New York University, an M.A. in environmental geography/geographic information systems from Hunter College/CUNY, and a B.Sc. in Environmental Analysis and Design from Cornell University.

Stefan Becker

Dr. Stefan Becker is a professor and chair in Lehman College's EGGS Dept. He received his doctorate (Dr. rer. nat.) from the Justus-Liebig-University Giessen (Germany). In addition to his work experience in the United States, Dr. Becker has pursued his career by working at universities in various countries: The main work for his dissertation was done at the Tel Aviv University (Israel); he did his postdoctoral studies at the University of the Witwatersrand, Johannesburg, South Africa and received his habilitation from the Justus-Liebig-University Giessen (Germany). Before joining Lehman College in August 2010, Dr. Becker was employed as full-time instructor and researcher at the University of Wisconsin Oshkosh. He also is a faculty member in the Earth and Environmental Sciences Ph.D. program at the CUNY Graduate Center.

Dr. Becker has been particularly interested in atmospheric processes and regional impacts of climatic and environmental change. He has studied temporal and spatial variability of rainfall patterns in Tibet and in the Yangtze River basin in China and their impact on flood events based on atmospheric modeling, nonlinear statistical analysis, and GIS applications. Recent works have led him to focus on developing future scenarios and improving the forecast of severe flood events in the region. Furthermore, Dr. Becker has studied the distribution of air pollution from coal-fired power stations and their impact on humans in South Africa based on statistical models and GIS applications. Other research projects include heat-stress in Israel and South Africa, regional impacts of climate change in Wisconsin, and wind energy potential in Germany. In recent years, his research has also focused on understanding and modeling of hurricane track and intensity changes in the Atlantic. Dr. Becker has published more than 30 peer-reviewed articles in international journals such as Theoretical and Applied Climatology, International Journal of Climatology, Stochastic Environmental Research and Risk Assessment (SERRA), Climate Research and others.

Dr. Becker has developed curricula and taught courses in physical geography, statistics, weather and climate, climatology, environmental conservation, environmental policy, as well as many other courses on regional geography.

Yuri Gorokhovich

Dr. Yuri Gorokhovich is an assistant professor in Lehman College's EGGS Dept. He received an M.S. in Engineering/Marine Geology from Odessa State University (Ukraine), and a Ph.D. in Earth and Environmental Sciences from the Graduate Center of the City University of New York. He was a research scientist and manager of the GIS unit at the New York City Department of Environmental Protection, and an associate research scientist at CIESIN, Columbia University, and has taught at Lehman, Columbia, City College, and Purchase College, SUNY.

His research interests include natural hazards and disasters, climatic studies, and Geographic Information Systems (GIS) modeling in applied geology and geography. Dr. Gorokhovich has taught Introduction to Geographic Information Systems; GIS Research, Environment, Infrastructure, Management; and Environmental Data Analysis. Graduate courses he teaches regularly in the GISc Program at Lehman are Natural Hazards and Risk Analysis with GISc; and Data Acquisition and Field Surveying Techniques.

Andrew Maroko

Dr. Maroko is an Assistant Professor in the Department of Health Sciences and the Department of Environmental, Geographic, and Geological Sciences. He received his Ph.D. and Master's degrees in Earth and Environmental Sciences (geography specialization) from the Graduate Center of the City University of New York (NY, NY), and his undergraduate studies in Biology were completed at Rutgers University. His doctoral dissertation was entitled *Chronic Exposure to Fine Particulate Matter and Heart Failure in New York City: A Methodological Exploration of Environmental Justice and Health*. Professor Maroko earned his bachelor's from Rutgers University (New Brunswick, NJ) while majoring in Biology. He now is an assistant professor in the health sciences department of Lehman College (CUNY) / CUNY School of Public Health. Dr. Maroko is also on the faculty of the CUNY Graduate Center's Ph.D. programs in Public Health (DPH) and Earth and Environmental Sciences. Professor Maroko has taught numerous courses at the graduate and undergraduate levels in geographic information science, spatial analysis, geography, and environmental health.

Andrew Maroko's research interest in health geographics centers on the spatial analysis of environmental health and equity issues. He is the associate director of the Urban GISc Lab at Lehman College and is actively involved in the research core of the CUNY Institute for Health Equity. His research has been published in leading journals, and includes work on environmental justice, exposure assessment, pollution modeling, geo-statistical analyses, computational geography, urban health geographics, accessibility, and geovisualization.

APPENDIX 3:

Letters of Support for Master's Program in GISc

- Emerging Health Information Technologies, Inc.
- Montefiore Medical Center/Albert Einstein College of Medicine
- New York City Department of Health and Mental Hygiene (DOHMH)
- Wildlife Conservation Society (WCS)
- CUNY Graduate Center Earth and Environmental Science Doctoral Program
- NOAA-CREST (National Oceanic and Atmospheric Administration
Cooperative Center for Remote Sensing Science and Technology)
- Lehman College Master's of Public Health Program
- New York City Department of Environmental Protection (DEP)