December 14, 2011

MEMORANDUM

TO: Robert Gold
    Dean, School of Public Health

FROM: Elizabeth Beise
    Associate Provost for Academic Planning and Programs

SUBJECT: Proposal to Modify the Ph.D. Program in Toxicology (PCC log no. 11028)

At its meeting on December 2, 2011, the Senate Committee on Programs, Curricula and Courses approved your proposal to modify the curriculum of the Ph.D. program in Toxicology. A copy of the approved proposal is attached.

The curriculum change is effective Spring 2012. Please ensure that the change is fully described in the Graduate Catalog and in all relevant descriptive materials, and that all advisors are informed.

MDC/

Enclosure

cc: David Salness, Chair, Senate PCC Committee
    Sarah Bauder, Office of Student Financial Aid
    Reka Montfort, University Senate
    Erin Howard, Office of Information Technology
    Donna Williams, Institutional Research & Planning
    Anne Turkos, University Archives
    Linda Yokoi, Office of the Registrar
    Arthur Popper, Graduate School
    Coke Farmer, School of Public Health
    Donald Milton, Maryland Institute for Applied Environmental Health
    Amy Sapkota, Maryland Institute for Applied Environmental Health
College/School:
Please also add College/School Unit Code-First 8 digits: 01203300
Unit Codes can be found at: https://hvpprod.umd.edu/Html_Reports/units.htm

Department/Program: Maryland Institute for Applied Environmental Health (1331701)
Please also add Department/Program Unit Code-Last 7 digits:

Type of Action (choose one):

- Curriculum change (including informal specializations)
- Renaming of program or formal Area of Concentration
- Addition/deletion of formal Area of Concentration
- Suspend/delete program

New academic degree/award program
New Professional Studies award iteration
New Minor
Other

Italics indicate that the proposed program action must be presented to the full University Senate for consideration.

Summary of Proposed Action:

The policies for implementing the Toxicology PhD program on the UMCP campus are not specified in the current Graduate Catalog and need updating following the move of the degree from CLFS/CMNS to SPHIL. The prior degree program was not aligned with CEPH criteria for accreditation of the School of Public Health. This proposal updates the curriculum bringing it into line with the current UM System Program in Toxicology policy and procedures and building on the strengths of the Maryland Institute for Applied Environmental Health in implementing the existing Toxicology and Environmental Health track of the UMS Program on the UMCP campus.

APPROVAL SIGNATURES - Please print name, sign, and date. Use additional lines for multi-unit programs.

1. Department Committee Chair
   Amy R. Sapkota
   11/2/11

2. Department Chair
   Donald Milton
   11/2/11

3. College/School PCC Chair
   Amy R. Sapkota
   11/2/11

4. Dean
   11/4/11

5. Dean of the Graduate School (if required)

6. Chair, Senate PCC
   David Salness
   12/13/11

7. University Senate Chair (if required)

8. Senior Vice President and Provost
   12/14/11
1. Background

The University of Maryland Graduate Program in Toxicology was authorized by the Board of Regents in 1984 to provide a multidisciplinary training and research program within the University of Maryland System. Established as an intercampus University of Maryland (UM) program, the Program in Toxicology encompasses faculty and resources at the University of Maryland Baltimore, College Park, Baltimore County, Eastern Shore, and Center for Environmental Studies' Chesapeake Biological Laboratory campuses. The inclusion of the research programs, faculty and resources of these institutions into one graduate program forms one of the most comprehensive Toxicology Programs in the nation. As an inter-institutional effort, the program has developed thematic strengths in mechanistic toxicology/cell injury, neurotoxicology, aquatic toxicology, forensic toxicology, and molecular epidemiology and analytical toxicology. The program currently has two tracks: Molecular & Mechanistic Toxicology; and Toxicology and Environmental Health. The Toxicology and Environmental Health track includes four focus areas: Environmental Epidemiology and Toxicology; Forensic and Analytical Toxicology; Aquatic Toxicology; and Risk Assessment and Environmental Law. Students in the Aquatic Toxicology focus are largely based at the Chesapeake Biological Laboratory while students in the other focus areas are mostly based in Baltimore. The University of Maryland Baltimore has been the lead institution in the Toxicology Program for the 20 years of its existence.

Participation in the program by UMCP faculty and students has primarily been from the (former) College of Chemical and Life Sciences, and primarily by Prof. Amy Brown and Prof. Judd Nelson from the department of Entomology. However, for the last 10 years, their students have typically chosen to enroll in the PhD in Marine, Estuarine and Environmental Sciences as this program reflects the ecosystem focus of much of their work.

The Maryland Institute of Applied Environmental Health (MIAEH) was established in 2006 with a mission to carry out research on a broad range of environmental factors and their effects on human health. Faculty members in MIAEH collaborate with state, federal, international and private agencies to develop research solutions that address pressing environmental and occupational health problems. MIAEH currently offers students flexible and individualized programs of study that lead to the Master of Public Health in Environmental Health Sciences. Faculty in MIAEH are currently funded by the National Institute for Environmental Health Science, other NIH institutes, and the Centers for Disease Control and Prevention. Thus, the research of Public Health faculty within MIAEH is well-aligned with the goals of the Toxicology program and focused on Environmental Health Science, rather than on ecosystem health and environmental science that are the foci of the graduate programs in Environmental Science and Technology and the system program in Marine, Estuarine and Environmental Sciences currently offered by other colleges, AGNR and CMNS, respectively. Therefore, because MIAEH would be a natural home for students interested in pursuing doctoral research in environmental health science, the Dean of CMNS (in consultation with department chairs from the former CLFS) and the Dean of SPHl requested that the Toxicology program be reassigned within UMCP to the School of Public Health. At its May 6, 2011 meeting the Senate Committee on Programs, Curricula and Courses approved the proposal to move the PhD program in Toxicology to the School of Public Health effective Fall 2011 (PCC log no. 10049).
Following transfer of the program, MIAEH faculty worked with UMB program director Katherine Squibb to develop a detailed curriculum to implement the “Toxicology and Environmental Health” track, for students on the UMCP campus. Students in this track on the UMCP campus will be offered graduate training in applied areas of toxicology, with a focus on the translation of basic knowledge of chemical metabolism and mechanisms of cellular toxicity and carcinogenicity to diseases in human populations. Students will become experts in exposure assessment, identification of susceptible populations and the role of risk assessment in developing environmental health policy and regulations. They will also obtain a broad appreciation of public health as required for students graduating from a School of Public Health accredited by the Council on Education in Public Health.

This proposal seeks to establish the Maryland Graduate Program in Toxicology’s existing track for Toxicology and Environmental Health at UMCP with a focus on human health, environmental epidemiology, risk assessment, and environmental justice consistent with the areas of expertise of the MIAEH faculty. This proposal does not preclude future participation of other faculty on the UMCP campus who may want to develop additional focus areas within the toxicology program, e.g. Ecosystem Health or Aquatic Toxicology. However, the Toxicology PhD on the UMCP campus will remain distinct from the environment related PhDs offered by AGNR and CMNS, and the Toxicology Program degrees offered on other USM campuses by its requirement that all graduates have a background in all five core disciplines of public health.

In section 2 we present under the title “Old Requirements”, a description of the program from the 2004 self study (no curriculum details specific to the UMCP campus were available in the catalog or other administrative files at the time of this writing). The old requirements are presumably similar to those in place when the last UMCP students participated in the program over 10 years ago. In section 3 we present under the title “New Requirements” a revision of the old requirements that is consistent with current System Graduate Program in Toxicology requirements and procedures for the qualifying examination, and appropriate to the Toxicology and Environmental Health track.

2. Old Requirements

From the University of Maryland System-Wide Program in Toxicology Graduate Program Review Self Study, April 2004:

Toxicology Program Requirements

Specific program requirements for the Non-Thesis MS degrees in toxicology include a minimum of 30 course credits (meeting the course requirements outlined below), successful completion of a written comprehensive exam, and a scholarly paper written under the direction of the student’s chosen advisor.

Program requirements for the Thesis MS degree in toxicology include a minimum of 30 course credits (meeting the course requirements outlined below), 6 credits of MS dissertation research, and a thesis defense.

Program requirements for a PhD degree in toxicology include course work established by the student’s examining committee, successful completion of a written comprehensive exam, oral defense of a written dissertation research proposal, 12 credits of PhD dissertation research and a final dissertation defense.

Core Course Curriculum
The toxicology course curriculum is designed to provide an essential core of knowledge in toxicology, together with elective courses that offer students the background needed to specialize. All students are required to take a minimum of 12 credits in toxicology, 2 laboratory rotations, 2 credits of toxicology seminar, 3 credits in biostatistics, 1 credit in scientific ethics and 6 credits in two of the following four areas: analytical chemistry, pharmacology, pathology and epidemiology. Attendance at Toxicology Seminars is required even if students are not enrolled for credit. Students may take advantage of courses offered on any of the campuses of the University of Maryland, as long as they take the indicated number of hours of credit from courses offered in each subject area.

Students are able to customize their selection of courses and lab rotations based on their specific career objectives. Final approval of a student’s coursework is given by the student’s examining committee when the student is admitted to candidacy.

**PhD Comprehensive Examination and Admission to Candidacy Requirements**

As early as the end of a student’s third semester, but no later than the end of their third year in the program, a student must pass written and oral qualifying examinations. The student’s examining committee for their comprehensive exams must consist of five members, three of which must be full graduate faculty from within the University System of Maryland. The student’s written exam is prepared by his/her examining committee. Each faculty member submits questions for the one-day exam. Upon successful completion of the written exam, the student is required to prepare a written thesis proposal. The oral qualifying exam consists of a presentation and defense of the student’s thesis proposal. A thesis committee, made of five faculty members including the student thesis research mentor, is formed and assigned the task of supervising the student’s thesis proposal and research. The final dissertation defense examining committee of five is appointed by the Graduate School.

3. **New Requirements**

**Toxicology Program Requirements for the Toxicology and Environmental Health Track at UMCP**

Admission to the program is generally limited to PhD students. Specific program requirements for the Non-Thesis MS degrees in toxicology include a minimum of 46 course credits (meeting the course requirements outlined below), successful completion of a written comprehensive exam at the MS level, and a scholarly paper written under the direction of the student’s chosen advisor.

Program requirements for the Thesis MS degree in toxicology include a minimum of 46 course credits (meeting the course requirements outlined below), successful completion of a written comprehensive exam at the MS level, 6 credits of MS thesis research, and a thesis defense.

Program requirements for a PhD degree in toxicology include completing the core curriculum described below and additional course work established by the student’s examining committee, successful completion of a written comprehensive exam, oral defense of a written research proposal, a minimum of 12 credits of PhD dissertation research and a final dissertation defense.

**Core Course Curriculum**

The curriculum for the Toxicology and Environmental Health track is designed to provide an essential core of knowledge in toxicology and environmental and occupational health, together with elective courses that offer students the background needed to specialize within this broad
area. Students are required (except as noted below) to take a minimum of 12 credits in toxicology and environmental and occupational health, 2 laboratory rotations for 3 credits each, 3 credits of environmental health seminar, 6 credits each to cover the basic courses in biostatistics and epidemiology, 1 credit in scientific ethics, and 6 credits in two of the following areas: epidemiology/biostatistics, analytical chemistry, pharmacology, pathology/immunology/microbiology, or environmental science/ecology/climate. Students without prior training in physiology are recommended to take mammalian physiology or an equivalent course before matriculation, or during the first semester. Attendance at Environmental Health Seminars is required even if students are not enrolled in the seminar class that semester.

Students without a prior MPH from a CEPH accredited program or school of public health must demonstrate basic competency in health behavior and health services administration either by meeting criteria set by the respective faculties at UMSPH, by taking 3 credits each in health behavior and health services administration as part of the Ph.D. program, or taking an alternative course designed to cover these topics as designated by the Graduate Public Health Committee of the School of Public Health. Students may, with approval from their advisor and committee, count prior course work taken at Maryland or another university as meeting the basic requirements in epidemiology, biostatistics, and other required areas, but at a minimum must take courses within the University of Maryland system to meet requirements for 12 credits of toxicology and environmental and occupational health, two laboratory rotations for 3 credits each, and 6 credits each in two areas of specialization as described above.

Students may take advantage of courses offered on any of the campuses of the University of Maryland, as long as they take the indicated number of hours of credit from courses offered in each subject area.

Students are able to customize their selection of courses and lab rotations based on their specific career objectives. Students must file with the graduate program director a preliminary plan of study, signed by their advisor, before registering for their first semester of classes and an amended plan of study before the end of their second semester. The program of study will describe how the proposed course work will meet the requirements of the core curriculum. The MIAEH graduate program committee shall review all programs of study for pre-candidacy doctoral students on an annual basis to ensure that each student meets program requirements. The student’s examining committee gives final approval of a student’s coursework when the student is admitted to candidacy.

**PhD Comprehensive Examination and Admission to Candidacy Requirements**

As early as the end of a student’s third semester, but no later than the end of their third year in the program, a student must pass written and oral qualifying examinations. The student’s examining committee for their comprehensive exams must consist of five or six Graduate Faculty members, three of whom must be full members of the Graduate Faculty and one committee member who must have a primary appointment outside of MIAEH. The mentor and the director of the toxicology graduate program at UMCP will automatically be members of the committee. The mentor serves as chair.

The format of the qualifying examination will be set in coordination with the University System of Maryland Program in Toxicology steering committee and may consist of a) written questions from the examining committee or b) direction of the student to write an NIH R01 format research proposal on a topic that will not be part of the dissertation research. The oral portion
of the qualifying examination will take place no earlier than 15 days after the written examination or research proposal is submitted to the committee and will be based on the content of the written examination or proposal and other questions related to the topic covered in the core courses and area of the student’s specialization. The qualifying examination will be graded as follows: Pass Ph.D. level, Pass M.S. level, and Fail. The exam may be taken a second time.

After passing the written and oral qualifying examinations the student will be admitted to candidacy and the examining committee will serve as the thesis committee. The candidate will then write a dissertation research proposal in consultation with the committee, submit the written proposal to the committee at least 2 weeks prior to a scheduled oral defense of the proposal, and finalize the proposal following the oral defense. During the course of the research, the candidate will meet with the committee at least once every six months and the mentor/chair will submit a progress report, signed by all committee members, to the director of the Toxicology and Environmental Health Track at UMCP following each meeting. The Ph.D. dissertation shall contain a minimum of three chapters containing complete papers published or submitted for publication to peer-reviewed scientific journals prior to the examination, together with such introductory, summary, and supporting materials as deemed appropriate by the thesis committee. The procedures for the dissertation defense and examining committee are as specified in the Graduate School Catalog.

4. Reasons for Changes

The policies for implementing the Toxicology PhD program on the UMCP campus are not specified in the current Graduate Catalog and need updating following the move of the degree from CLFS/CMNS to SPHL. The prior degree program was not aligned with CEPH criteria for accreditation of the School of Public Health.

5. Sample Program Plan

A plan of study meeting the requirements of the PhD program could include the following example. This student is described as focusing on environmental and occupational health microbiology:

<table>
<thead>
<tr>
<th>Toxicology and Environmental and Occupational Health</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MIEH720 Toxicology</td>
<td>3</td>
</tr>
<tr>
<td>MIEH740 Risk Assessment</td>
<td>3</td>
</tr>
<tr>
<td>MIEH770 Law &amp; Policy in EH</td>
<td>3</td>
</tr>
<tr>
<td>MIEH771 Exposure Assessment</td>
<td>3</td>
</tr>
<tr>
<td>MIEH773 Biological Contaminants in the Env.</td>
<td>3</td>
</tr>
<tr>
<td>MIEHxxx** Molecular Epidemiology for Env Health</td>
<td>3</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Basic Epidemiology and Biostatistics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EPIB610 Epidemiology I</td>
<td>3</td>
</tr>
<tr>
<td>EPIB611 Epidemiology II</td>
<td>3</td>
</tr>
<tr>
<td>EPIB650 Biostatistics I</td>
<td>3</td>
</tr>
<tr>
<td>EPIB651 Biostatistics II</td>
<td>3</td>
</tr>
</tbody>
</table>
### Advanced Epidemiology and Biostatistics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPIB621</td>
<td>Infectious Disease EPI</td>
<td>3</td>
</tr>
<tr>
<td>MIEHxxx**</td>
<td>Spatial Epidemiology</td>
<td>3</td>
</tr>
</tbody>
</table>

Subtotal: 6

### Advanced Environmental Science/Ecology/Climate

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEES698E</td>
<td>Ecosystem Restoration</td>
<td>3</td>
</tr>
<tr>
<td>MEES608C</td>
<td>Diseases in Chesapeake Bay</td>
<td>3</td>
</tr>
<tr>
<td>MIEHxxx**</td>
<td>Env Justice</td>
<td>3</td>
</tr>
</tbody>
</table>

Subtotal: 9

### Other Requirements

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPIB641</td>
<td>Ethics in PH</td>
<td>1</td>
</tr>
<tr>
<td>TOX609</td>
<td>Methods in Toxicology (Laboratory Rotation)</td>
<td>6</td>
</tr>
<tr>
<td>MIEH688</td>
<td>Seminar in EH</td>
<td>3</td>
</tr>
<tr>
<td>HLTH665</td>
<td>Health Behavior</td>
<td>3</td>
</tr>
<tr>
<td>HLSA601</td>
<td>H. Service Admin</td>
<td>3</td>
</tr>
</tbody>
</table>

Subtotal: 16

* It is expected that many students will take more than the minimum number of credits unless they have highly relevant course work from a prior masters degree.

** New courses to be offered by recently recruited MIAEH faculty starting in the spring and fall semesters of 2012.

The student’s program plan could be executed as follows:

### Year 1

#### Fall

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPIB610</td>
<td>Epidemiology I</td>
<td>3</td>
</tr>
<tr>
<td>EPIB650</td>
<td>Biostatistics I</td>
<td>3</td>
</tr>
<tr>
<td>BIOL708N</td>
<td>Mammalian Physiology</td>
<td>3</td>
</tr>
<tr>
<td>MIEH773</td>
<td>Biological Contaminants</td>
<td>3</td>
</tr>
<tr>
<td>MIEH688</td>
<td>Seminar in EH</td>
<td>1</td>
</tr>
</tbody>
</table>

Semester total: 13

#### Spring

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIEH720</td>
<td>Toxicology</td>
<td>3</td>
</tr>
<tr>
<td>MIEH 771</td>
<td>Exposure Assessment</td>
<td>3</td>
</tr>
<tr>
<td>EPIB611</td>
<td>Epidemiology II</td>
<td>3</td>
</tr>
<tr>
<td>EPIB651</td>
<td>Biostatistics II</td>
<td>3</td>
</tr>
<tr>
<td>MIEH688</td>
<td>Seminar in EH</td>
<td>1</td>
</tr>
</tbody>
</table>

Semester total: 13
Year 2

Fall
- MIEH770 Law & Policy in EH 3
- MIEH740 Risk Assessment 3
- EPIB621 Infectious Disease Epidemiology 3
- TOXI609 Methods 3
- EPIB641 Ethics in P.H. 1
Semester total 13

Spring
- MIEHxxx Env Justice 3
- HLTH665 Health Behavior I 3
- TOXI609 Methods 3
- MIEHxxx Spatial Epidemiology 3
Semester total 12

Year 3

Fall
- HLSA601 Health Service Admin. 3
- MEES698E Ecosystem Restoration 3
- MEES608C Diseases in C. Bay 3
- TOXI898 3
   Semester Total 12

Spring
- TOXI899 6

Year 4-5

Fall
- TOXI899 6

Spring
- TOXI899 6

6. Prerequisite structure of all required or optional courses
   No change from MPH program

7. Resources
   MIAEH has the necessary faculty to teach the necessary courses and advise doctoral candidates. No new resources are requested. Three newly recruited faculty members started tenure-track appointments in MIAEH as of August 2011. The new faculty members are preparing courses on the following topics to be offered beginning in 2012: Spatial Epidemiology and Statistics for Environmental Health, Environmental Justice, and Molecular Epidemiology for Environmental Health. In addition a courses previously listed but not taught, MIEH 770 Law and Policy in Environmental Health, will now be offered.

8. List of Deleted Courses
   None

9. Toxicology PhD Competencies and Learning Outcomes Assessment
See attached “Competencies, Outcomes, and Assessments”.

10. Letters from Departments
   MEES, BIOL

11. Impact on Current and Transfer students (if any)
   No current students.
September 9, 2011

Donald K Milton, MD, DrPH
Professor and Director
Maryland Institute for Applied Environmental Health
School of Public Health
University of Maryland
SPH Building 255
College Park, MD 20742-2611

Dear Dr. Milton:

I am pleased to let you know that the UM System Program in Toxicology Steering Committee has approved your curriculum proposal and list of competencies and outcome assessments for the Toxicology/Environmental Health Track PhD program you are activating in your School of Public Health. We look forward to developing collaborative activities with your faculty and students during the coming year.

Regards,

Katherine S. Squibb, PhD
Co-Director, UM System Program in Toxicology
September 22, 2011

Donald K. Milton, MD, DrPH
Professor and Director
Maryland Institute for Applied Environmental Health
School of Public Health
University of Maryland
SPH Building 255
College Park, MD 20742-2611

Dear Dr. Milton:

I am writing to let you know that we here at the University of Maryland, Marine Estuarine Environmental Sciences (MEES) graduate program support inclusion of MEES courses the updated curriculum for the UM System Toxicology PhD Program Environmental Health Track in the School of Public Health’s Maryland Institute for Applied Environmental Health. We look forward to seeing Toxicology PhD students in our graduate classes and eagerly anticipate future collaborative opportunities with your faculty and students.

Sincerely,

[Signature]

Dr. Ken Paynter
MEES Director
University of Maryland, College Park
Letter from CMNS supporting the Toxicology Program PhD curriculum proposal.

Don

From: Jeffrey S. Jensen
Sent: Sunday, September 11, 2011 6:06 PM
To: Donald K. Milton
Cc: Jeffrey S. Jensen; Gerald S. Wilkinson; Robert L. Infantino
Subject: Re: Toxicology PhD, Relevant to BSCI440

Dear Don,

I have discussed this with the course faculty and the department chair. All support inclusion of BIOL708N Advanced Topics in Biology: Mammalian Physiology; (3 credits) in the Toxicology program. Please feel free to include the course as part of your PCC proposal.

Best wishes,

Jeff

Dr. Jeffrey S. Jensen
Associate Chair and Director of Undergraduate Studies
Department of Biology
Biology/Psychology Building
University of Maryland
College Park, MD 20742

email: jensen@umd.edu
phone: 301-405-5912
1. **Synthesize toxicological and environmental health knowledge identifying opportunities to advance the field of toxicology and environmental health.**

   Measure: Successful completion of the qualifying examination  
   Criterion: 100% of graduates will pass the examination.  
   Assessment: A portfolio will be compiled for each student in the program and reviewed annually by the graduate program committee to assess the rigor and quality of the examinations and student performance.

2. **Develop testable hypotheses that will advance the field toxicology and environmental health.**

   Measure: Successful completion of the qualifying examination, dissertation research proposal, and oral defense of the dissertation proposal  
   Criterion: 100% of graduates will pass the examination, prepare and defend a research proposal.  
   Assessment: A portfolio will be compiled for each student in the program and reviewed annually by the graduate program committee to assess the rigor and quality of the research proposals.

3. **Design and conduct research studies, analyze data and test hypotheses that advance the science of toxicology and environmental health.**

   Measure: Successful completion of dissertation research and submission of a completed dissertation  
   Criterion: 80% of graduates will submit a dissertation within 5 years and 95% within 6 years of matriculation.  
   Assessment: The time to graduation will be assessed after there are at least six graduates from the program and annually thereafter.

4. **Effectively communicate results of research to the scientific community.**

   Measure: Successful publication of research in peer reviewed journals and acceptance of abstracts at scientific conferences.  
   Criterion: 100% of graduates will present research either as posters or podium presentations at scientific meetings, 100% will have submitted three research papers to peer reviewed journals, and 80% will have at least one paper accepted and 50% will have two papers accepted for publication prior to defending their dissertation.  
   Assessment: A portfolio will be compiled for each student and reviewed annually by the graduate program committee to assess whether students are being required to submit well prepared manuscripts for publication prior to dissertation defense.
5. **Communicate research results in a way that makes new knowledge accessible to policy makers and stakeholders.**

   Measure: News coverage quoting the student scientist, presentations to community groups, government officials, and legislators, lay-language research reports for stakeholders.

   Criterion: 50% of graduates will appear in news coverage of their research, 80% of graduates will give presentations to stakeholders, and 90% will prepare lay-language reports such as to research participants and interested community groups and others.

   Assessment: A portfolio will be compiled for each student and reviewed annually by the graduate program committee to assess whether communication to the public is actively pursued.

6. **Demonstrate commitment to environmental health equity.**

   Measure: Inclusion of women, persons of color (particularly socially disadvantaged minorities), economically disadvantaged, and children in research, where appropriate, and among recipients of communication efforts.

   Criterion: 50% of graduates will focus their work on environmental justice and/or the impacts of environmental factors on women, persons of color (particularly socially disadvantaged minorities), economically disadvantaged, children, and/or other vulnerable populations, 100% will include economic status, race, and ethnicity as factors when analyzing epidemiologic data from the US and other appropriate categories when analyzing human data from other parts of the world, and 75% will target stakeholder communications to vulnerable communities.

   Assessment: A portfolio will be compiled for each student and reviewed annually by the graduate program committee to assess commitment on the part of students.

7. **Demonstrate commitment to engaging impacted communities and populations in applied, action-oriented environmental health research.**

   Measure: to engaging impacted communities and populations in applied, action-oriented environmental health research.

   Criterion: Participation in training and research activities that use community engagement and outreach approaches such as community-based participatory research or community-university partnerships

   Criterion: 100% of graduates will learn about CBPR, community-university partnerships, service-learning, or other community engagement and outreach approaches as part of the curriculum. For studies involving state-level environmental health issues and/or differentially burdened, exposed, risk, or health disparity populations in the state of Maryland, 50% of our graduates will apply community engagement
approaches or frames such as community-based participatory research as part of question development, study design, analysis, dissemination, and translation of results into interventions, policy, and other activities.

Assessment: A portfolio will be compiled for each student and reviewed annually by the graduate program committee to assess learning and commitment on the part of students.