



**MS and PhD Guidelines for  
Graduate Students in Public Health  
2014-2015**

# Master of Science in Public Health

The Master of Science (M.S.) degree program in Public Health (PH) is designed with an emphasis on mastering the skills in individual specialty areas within public health. Programs are currently offered in Biostatistics and Chronic Disease Epidemiology.

The length of study leading to the M.S. degree is one year full-time for the Chronic Disease Epidemiology track and two years full-time for the Biostatistics track. Part-time students must complete the degree within five years of matriculation.

The M.S. in PH is offered through the School's affiliation with the Graduate School of Arts and Sciences. The Graduate Studies Executive Committee (GSEC) and the director of graduate studies (DGS) are responsible for overseeing the progress of M.S. students.

## BIOSTATISTICS TRACK (BIS)

The M.S. in Biostatistics is a two-year program. It is designed to train students to meet the growing need in managed care organizations, medical research, and the pharmaceutical industry for graduates with technical skills in data analysis. In contrast to the more general M.P.H. degree, the M.S. degree emphasizes the mastery of biostatistical skills from the beginning of the plan of study. While graduates of this program may apply to the Ph.D. degree program, the M.S. degree is itself quite marketable as a terminal degree.

### *Degree Requirements*

The Biostatistics track requires a minimum of 12 courses (excluding the Ethics course, EPH 600b; and BIS 525a and b, BIS 695c) plus a master's thesis.

### *Curriculum*

#### REQUIRED COURSES

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
†BIS 525a and b	Seminar in Biostatistics	n/a
BIS 540a	Fundamentals of Clinical Trials	1
BIS 623a	Applied Regression Analysis	1
BIS 625a	Categorical Data Analysis	1
BIS 628b	Longitudinal and Multilevel Data Analysis	1
BIS 630b	Applied Survival Analysis	1
†BIS 695c	Summer Internship in Biostatistical Research	n/a
†EPH 600b	Research Ethics and Responsibility	n/a
*STAT 541a	Probability Theory	1
*STAT 542b	Theory of Statistics	1

\*These courses are offered in the Graduate School of Arts and Sciences.

†These courses do not count toward the twelve required courses.

In addition, students must complete five elective courses and a master's thesis. Two of the electives must be in Biostatistics, chosen from the list below, and one must be in Public Health (not Biostatistics). Two additional electives are required and can be taken in any area relevant to the student's interest.

Biostatistics electives are to be selected from these courses: BIS 557a, Computational Statistics; BIS 561b, Advanced Topics and Case Studies in Multicenter Clinical Trials; BIS 643b, Theory of Survival Analysis; BIS 646b, Nonparametric Statistical Methods and Their Applications; BIS 651b, Spatial Statistics in Public Health; and BIS 691b, Theory of Generalized Linear Models. Students demonstrating a mastery of topics covered by the required courses may replace them with more advanced courses but must receive written permission from the DGS prior to enrolling in the substitute courses.

### *Competencies*

Upon receiving an M.S. in Public Health, with a concentration in Biostatistics, the student will be able to:

- Describe advanced concepts of probability, random variation, and commonly used statistical probability distributions.
- Develop an efficient design for collecting, recording, and storing data collected in the conduct of public health and medical research.
- Develop sample size and statistical power calculations for basic study designs including those utilized in clinical trials.
- Design efficient computer programs for study management, statistical analysis, as well as presentation using SAS and other programming languages.
- Produce edited data sets suitable for statistical analyses.
- Apply advanced informatics techniques with vital statistics and public health records in the description of public health characteristics and in public health research and evaluation.
- Perform analyses of stated hypotheses using a variety of analytical tools including analysis of variance, multiple regression, nonparametric statistics, logistic regression, multivariate analyses, and methods for analyzing rates and failure-time data.
- Interpret results of advanced statistical analyses and use these results to make relevant inferences from data.
- Produce working tables and statistical summaries describing research in health science.
- Develop written presentations based on intermediate to advanced statistical analyses for both public health professionals and educated lay audiences.
- Develop oral presentations based on intermediate to advanced statistical analyses for both public health professionals and educated lay audiences.

### *Master's Thesis*

In the second year of the program, the student is required to execute a program of independent research under the direction of a faculty member. This project usually falls into one of these main areas:

1. Development of a new statistical theory or methodology.
2. A computer-based simulation study to illustrate properties of an existing method.
3. The analysis of a real data set.

The student is required to prepare a written thesis under the supervision of a Biostatistics faculty member. Upon completion of the thesis, the student will make an oral presentation of the results of his/her work.

For specific instructions on the organization, mechanics, and publication of the thesis, see Appendix II: Thesis Guidelines.

## CHRONIC DISEASE EPIDEMIOLOGY TRACK (CDE)

There is a high demand for well-trained graduates in chronic disease epidemiology. This track provides intensive training in epidemiology and research methods for medical and health care professionals, or others seeking the skills necessary to conduct epidemiological research in their professional practice.

Applicants should have a basic understanding of quantitative science and statistics. It is recommended that candidates have strong science backgrounds and demonstrated competency in statistical analysis and logical thinking. Applicants from rigorous programs in the biological or social sciences will be given preference. At a minimum, applicants should have one year of course work in statistics or the equivalent prior to enrolling in this program. Summer courses are available to fulfill this requirement. Full-time applicants are preferred.

### *Degree Requirements*

The CDE track consists of required and elective course work and satisfactory completion of the Capstone experience. A total of ten courses is required (excluding the Ethics course, EPH 600b; and Seminar, CDE 525). It is expected that this program will be completed during a single academic year. Students with an M.P.H. or other related degrees may be eligible to substitute advanced courses for some of the required courses. Written permission of the DGS is required prior to enrolling in substitute courses.

### *Curriculum*

#### REQUIRED COURSES

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
BIS 623a	Applied Regression Analysis	1
BIS 625a	Categorical Data Analysis	1
BIS 630b	Applied Survival Analysis	1
CDE/EMD 508a	Principles of Epidemiology I	1
CDE 516b	Principles of Epidemiology II	1
CDE 523b	Measurement Issues in Chronic Disease Epidemiology	1
†CDE 525a,b	Seminar in Chronic Disease Epidemiology/Social and Behavioral Sciences	n/a
*CDE 617b	Developing a Research Proposal	1
†EPH 600b	Research Ethics and Responsibility	n/a
Suggested electives (three courses are required):		
BIS 511a	GIS Applications in Epidemiology and Public Health	1
BIS 540a	Fundamentals of Clinical Trials	1
BIS 561b	Advanced Topics and Case Studies in Multicenter Clinical Trials	1
BIS 643b	Theory of Survival Analysis	1

BIS 645b	Statistical Methods in Human Genetics	1
CDE/EHS 520b	Case-Based Learning for Genetic and Environmental Diseases	1
CDE 531a	Health and Aging	1
CDE 532b	Epidemiology of Cancer	1
CDE 533b	Topics in Perinatal Epidemiology	1
CDE 535b	Epidemiology of Heart Disease and Stroke	1
CDE 562a	Nutrition and Chronic Disease	1
CDE 597a	Genetic Concepts in Public Health	1
*CDE 600a or b	Directed Readings	1
CDE 634b	Advanced Applied Analytical Methods in Epidemiology and Public Health	1
CDE 650a	Introduction to Evidence-Based Medicine and Health Care	1

\*In the capstone course CDE 617b, the student is required to develop a grant application that is deemed reasonably competitive by the instructor. An alternative to this capstone course is an individualized tutorial (CDE 600a or b), in which the student completes a manuscript that is suitable for submission for publication in a relevant journal.

†These courses do not count toward the ten required courses.

### *Competencies*

Upon receiving an M.S. in Public Health, with a concentration in Chronic Disease Epidemiology, the student will be able to:

- Explain and apply the terminology and definitions of epidemiology.
- Evaluate the scientific merit and feasibility of epidemiologic study designs.
- Describe the epidemiology of common chronic diseases.
- Synthesize information from a variety of epidemiologic and related studies.
- Design and carry out epidemiologic studies, with minimal supervision.
- Analyze data and draw appropriate inferences from epidemiologic studies at an intermediate to advanced level, using a variety of analytical tools including multivariate logistic regression, Poisson regression, linear regression, and survival analysis.
- Write an epidemiologic research proposal or a publishable epidemiologic article.
- Identify, interpret, and use routinely collected data on disease occurrence.
- Review, critique, and evaluate epidemiologic reports and research articles at an intermediate level.

# Doctoral Degree

Doctoral training has been part of Yale's mission since early in its history. The University awarded the first Ph.D. in North America in 1861, and the doctoral program in public health began with the establishment of the department in 1915. Six years later, in 1922, Yale conferred the Doctor of Philosophy (Ph.D.) in Public Health on two candidates.

Within the Yale academic community, the Ph.D. is the highest degree awarded by the University. The School of Public Health offers studies toward the Ph.D. degree through its affiliation with the Graduate School of Arts and Sciences. The Graduate School makes the final decisions on accepting students into the program, admission to candidacy, and awarding the degree.

The primary mission of the doctoral program in Public Health (PH) is to provide scholars with the disciplinary background and skills required to contribute to the development of our understanding of better ways of measuring, maintaining, and improving the public's health. The core of such training includes the mastery of research tools in the specialty discipline chosen by the candidate. Public health spans disciplines that use tools available in the laboratory, field research, social sciences, the public policy arena, and mathematics. Students engage in a highly focused area of research reflecting scholarship at the doctoral level but are exposed to a broad view of public health as seen in the diverse research interests of the School's faculty.

## COMPETENCIES FOR THE PH.D. IN PUBLIC HEALTH

Upon receiving a Ph.D. in Public Health, the student will be able to:

- Critically evaluate public health and related literature.
- Discuss and critically evaluate the broad literature of the student's discipline.
- Review in depth the background and research advances in the student's specific research area.
- Apply at an advanced level the research methodology of the student's broader discipline and, in particular, the student's specific research area.
- Present research to colleagues and professionals on a national and international level at professional meetings.
- Design a course in the student's broad discipline.
- Explain the principles of research ethics and apply these principles to specific research projects.
- Design and conduct an advanced, original research project in the student's discipline.
- Generate data to create publishable manuscripts that represent important contributions to the literature.

## ACADEMIC ADVISING

Each student is assigned to an academic adviser at the time of matriculation. The academic adviser is available for help with general academic questions, course selections, choosing a dissertation project, and preparation for the qualifying examinations. A student may request a change of his or her academic adviser by writing to the director of graduate studies (DGS). The request must be co-signed by both the previous and new academic advisers.

## TEACHING FELLOWSHIPS

Teaching experience is regarded as an integral part of the graduate training program and is typically completed during the second and third years of study. First-year students are encouraged to focus their efforts on course work and in most instances are not permitted to serve as Teaching Fellows. However, first-year students may be allowed to serve as Teaching Fellows if they have been awarded advanced standing. Advanced standing is only available to students who have completed previous graduate study at Yale (e.g., M.S. or M.P.H. programs). If a student has been awarded one year of advanced standing, he or she will be allowed to teach in both the fall and spring terms of the first year. If a student has been awarded one term of advanced standing, he or she will only be allowed to teach during the spring term of the first year.

All doctoral students are required to complete 40 hours (four Level 2 assignments at 10 hours/week or an equivalent combination) as a Teaching Fellow. Graduate research assistantship opportunities may take the place of teaching in the third year of study. A waiver of 10 hours is possible if the student is working as a Project Assistant (generally no more than 10 hours per week and with prior approval of the DGS). By year four, all students are expected to be engaged in full-time research activities.

## DEGREE REQUIREMENTS

There are five departments in PH in which doctoral students may choose a specialty. Requirements for each department vary and are outlined below under Departmental Requirements. In addition, all candidates for the Ph.D. degree must conform to the requirements of the Graduate School of Arts and Sciences.

### *Required Course Work*

The normal requirement for the degree of Doctor of Philosophy is typically four to five years of graduate study. Generally, the first two years are devoted primarily to course work. Each student must satisfactorily complete a minimum of ten courses or their equivalent and must satisfy the individual departmental requirements (see below for course requirements in each department). All first-year PH doctoral students are required to participate in a course covering both practical and theoretical issues in research ethics (EPH 600b, Research Ethics and Responsibility), and all first- and second-year students are required to take the Public Health Forum (EPH 650a and b). These two courses are in addition to the minimum required courses. The Graduate School requires that Ph.D. students achieve a grade of Honors in at least two doctoral-level courses. PH doctoral students are expected to maintain a High Pass average.

### *Qualifying Examinations*

The required qualifying examinations are usually taken at the end of the second year of study. In order to meet the different departmental needs, each department has developed a qualifying examination format; details are provided in each departmental program description below. The qualifying examinations serve to demonstrate that the candidate has mastered the background and the research tools required for dissertation research. The qualifying examinations are usually scheduled in June, all within a three-week

period. Students who have not completed the qualifying examinations with an average grade of High Pass by the end of their second year will not be permitted to register for the third year.

### *Prospectus Guidelines*

Before the end of the spring term of the third year, each student must submit a Dissertation Prospectus, i.e., a written summary of the planned nature and scope of the dissertation research, together with a provisional title for the dissertation. It is strongly recommended that students begin working with their adviser on this process early in the third year. Ideally students should submit the names of Dissertation Advisory Committee (DAC) members during the fall term of the third year and then submit the prospectus during the spring term of the third year. Students must have both the DAC members and the prospectus approved by the end of the third year (May).

The DAC consists of at least three members, including the thesis adviser, who will chair the committee. Two members are expected to be Yale School of Public Health faculty with a Graduate School appointment. Participation of faculty members from other departments is encouraged. An additional committee member may be selected from outside the University if he or she is a recognized authority in the area of the dissertation; a supporting curriculum vitae must be provided. The student should also submit a one-page proposal/description of the research plan and rationale for each committee member. The proposed DAC members must sign the one-page proposal/description stating that they have agreed to serve on the committee. Once the Graduate Studies Executive Committee (GSEC) approves the student's DAC, the student works with his or her committee to develop the prospectus.

The purpose of the prospectus is to formalize an understanding between the student, the DAC, and the GSEC regarding the scholarship of a proposed dissertation project. The prospectus should:

- Provide a detailed description of the research plan as outlined below, including title, topic, background, significance, study questions, analytic plan, and methods;
- Establish a consensus between the student, the DAC, and the GSEC that the research plan meets the requisite standards of originality, scope, significance, and virtuosity;
- Formalize the DAC's willingness to work with the student to see the proposed research plan to successful completion.

The prospectus should be written in clear, plain English with minimal jargon, abbreviations, or colloquialisms and is limited to a *maximum* of twenty pages (double-spaced). All tables, graphs, figures, diagrams, and charts must be included within the twenty-page limit. References are not part of the page limit. Be succinct and remember that there is no requirement to use all twenty pages. A prospectus found not to comply with these requirements will be returned without review.

The following format should be used (similar to NIH guidelines):

1. Title of proposed dissertation (can be a working title).
2. Specific aims (one page): A self-contained description of the project, which should be informative to other persons working in the same or related fields. State concisely the goals of the proposed research and summarize the expected outcome(s), including

the impact that the results of the proposed research will exert on the research field(s) involved.

3. Research strategy: Use the following subsections:
  - a. Significance: This section should place the research project in context and describe the proposed research in a manner intelligible to a nonspecialist. This should include a brief but critical evaluation of the relevant literature and a description of how the proposed research project will advance scientific knowledge and/or technical capability in one or more broad fields.
  - b. Innovation: Explain how the application challenges and seeks to shift current research paradigm(s). Describe any novel theoretical concepts, approaches or methodologies, instrumentation, or interventions to be developed or used, and any advantage(s) over existing methodologies, instrumentation, or interventions.
  - c. Approach: Outline the research project envisioned at this time and sketch out the plan to attain the overall goals of the project. Describe the overall strategy, methodology, and analyses to be used. Include preliminary data, if available. Acknowledge pitfalls and limitations of the research, and if possible suggest alternative strategies.
4. References: Should be included at the end (not counted in the page limit).

The prospectus submitted to the GSEC must be the version approved by the student's DAC and must be submitted together with the Submission of Dissertation Prospectus form.

The GSEC will review the prospectus and may request changes to either the DAC or the prospectus. Once the GSEC has approved the prospectus, it will be submitted to the Graduate School registrar.

Weekly meetings with the chair of the DAC are recommended. Regular face-to-face meetings of the full DAC are invaluable and are expected throughout the student's research toward the thesis. The DAC is expected to meet at least twice each year, and more frequently if necessary. Since dissertation progress reports at the Graduate School are due at the close of the spring term, it is advised that one of the meetings be scheduled in March or April. In doing so, the thesis adviser, student, and DGS will have current information on the student's progress for use in completing the dissertation progress report online. The student schedules the meetings of the DAC. The chairperson of the DAC, i.e., the thesis adviser, produces a summary report outlining progress and plans for the coming year. The document is to be distributed to the other committee members for comments. The student and the DGS are to receive a copy of the document from the DAC chair.

Because the prospectus is required fairly early in the dissertation research, the content of a thesis may change over time, and thus the student should not feel bound by what is submitted. However, major changes to the direction of research described in the prospectus should be discussed with the DAC and approved by the GSEC.

### *Admission to Candidacy*

After all predissertation requirements are successfully completed (course requirements, two Honors grades, overall High Pass average, qualifying examinations, dissertation prospectus), the student will be admitted to candidacy for the Ph.D. degree. These

requirements are typically met in three years. Customarily, students who have not been admitted to candidacy will not be permitted to register for the fourth year. Exceptions must be approved in advance by the DGS and the Graduate School associate dean. When students advance to candidacy, the registrar's office automatically submits a petition for the awarding of the M.Phil. degree.

## THE THESIS/DISSERTATION

The Ph.D. thesis in PH should be of publishable quality and represent a substantial contribution to the advancement of knowledge in a field of scholarship. The Graduate School policy in regard to the dissertation is as follows:

The dissertation should demonstrate the student's mastery of relevant resources and methods and should make an original contribution to knowledge in the field. The originality of a dissertation may consist of the discovery of significant new information or principles of organization, the achievement of a new synthesis, the development of new methods or theories, or the application of established methods to new materials. Normally, it is expected that a dissertation will have a single topic, however broadly defined, and that all parts of the dissertation will be interrelated. This does not mean that sections of the dissertation cannot constitute essentially discrete units. Dissertations in the physical and biological sciences, for example, often present the results of several independent but related experiments. Given the diverse nature of the fields in which dissertations are written and the wide variety of topics that are explored, it is impossible to designate an ideal length for the dissertation. Clearly, however, a long dissertation is not necessarily a better one. The value of a dissertation ultimately depends on the quality of its thought and the clarity of its exposition. In consultation with their faculty advisers and the director of graduate studies, students should give serious thought to the scale of proposed dissertation topics. There should be a reasonable expectation that the project can be completed in two to three years.

The dissertation may be presented as a single monograph as a major publication, or as (typically) a minimum of three first-authored scientific papers. One or more of the papers should be published, accepted for publication, or be in submission. The collected paper option does not imply that any combination of papers would be acceptable. For example, three papers related to background material (review papers), or three papers that reported associations of three unrelated exposures, or three papers of the same exposure but reporting different outcomes would not be acceptable. Rather, it is expected that the papers represent a cohesive, coherent, and integrated body of work. For example, one paper might be a systematic review and meta-analysis of the topic, another might develop a new methodological approach, and the third might apply those new methods to an area of current public health interest. In the collected paper option, the final thesis must include introductory and discussion chapters to summarize and integrate the published papers.

The DAC reviews the progress of the dissertation research and decides when the dissertation is ready to be submitted to the readers. This decision is made based on a closed defense of the dissertation. The dissertation defense involves a formal oral presentation to the DAC and other invited faculty. Upon completion of the closed defense, the chair of

the DAC submits its recommendation to the GSEC, and its recommendation of suitable readers.

There will be a minimum of three readers, one of whom is from PH, two with Yale Graduate School appointments, and one who is an authority in the dissertation research from outside the University. The selection of Yale faculty readers should include at least one senior faculty member. All readers must be recognized authorities in the area of the dissertation. The outside reader must submit a curriculum vitae for review by the GSEC. The outside reader should be an individual who has not collaborated previously with members of the student's dissertation committee and/or the student. Members of the DAC are not eligible to serve as readers. After the completed readers' reports are received by the Graduate School, they are reviewed by the DGS and the GSEC prior to making a School of Public Health recommendation to the Graduate School that the degree be awarded. The DAC may be asked to comment on the readers' reports before recommendations are made to the Graduate School.

### *Oral Presentation of the Doctoral Dissertation*

Doctor of Philosophy (Ph.D.) dissertations in PH must be presented in a public seminar. This presentation is scheduled after the submission of the dissertation to the readers and preferably prior to the receipt and consideration of the readers' reports. At least one member each of the DAC and GSEC is expected to attend the presentation. It is expected to be presented during the academic term in which the dissertation was submitted and must be widely advertised within YSPH.

## DEPARTMENTAL REQUIREMENTS

The specific requirements with regard to courses, qualifying examinations, and admission to candidacy set by PH departments are described below.

### *Biostatistics*

Biostatistics involves the development and application of sound statistical and mathematical principles to research in the health sciences. Because original theoretical research in biostatistics flows from medical research, it is essential that the foundations of methodological development be firmly grounded in sound principles of statistical inference and a thorough knowledge of the substantive area that provides the source of the medical questions being addressed. Thus, the Department of Biostatistics encourages excellent methodological work that is motivated by sound science that includes but is not limited to active collaborations with other investigators.

Research collaborations for biostatisticians take place both within and across departments in YSPH, as well as with other departments in the School of Medicine and the University at large. Areas of current research include development of general methods that have wide applicability across different areas of health research, as well as more specific techniques for dealing with the underlying processes that give rise to the data of interest. A broad range of health topics addressed by students in this department include chronic diseases such as cancer, genetic epidemiology, clinical research, and mathematical models for infectious diseases.

Graduates of the doctoral program in Biostatistics are employed in universities throughout the country, as well as in such dedicated research institutions as the National Institutes of Health. In addition, graduates have pursued careers in the pharmaceutical industry, in which they are actively involved in the evaluation of new therapeutic strategies.

**REQUIRED COURSE WORK**

Students in the department of Biostatistics prepare for their qualifying examination by taking the courses listed below. Course waivers must be recommended by the academic adviser and approved by the DGS.

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
BIS 525a and b	Seminar in Biostatistics	n/a
BIS 557a	Computational Statistics	1
BIS 610b	Applied Area Readings for Qualifying Exams	n/a
BIS 628b	Longitudinal and Multilevel Data Analysis	1
BIS 643b	Theory of Survival Analysis	1
BIS 646b	Nonparametric Statistical Methods and Their Applications	1
BIS 678a	Statistical Consulting	1
BIS 691b	Theory of Generalized Linear Models	1
BIS 695c	Summer Internship in Biostatistical Research	n/a
*STAT 610a	Statistical Inference	1
*STAT 612a	Linear Models	1

\*These courses are offered in the Graduate School of Arts and Sciences.

In consultation with their academic adviser, students choose a minimum of four additional electives that will best prepare them for dissertation work.

**QUALIFYING EXAMINATION**

The qualifying examination has two parts, the first being a written examination that demonstrates facility with the use of statistical principles to develop methods of application. The second involves the critical review of the statistical literature, report writing, and oral defense on a specific biomedical topic agreed upon by the candidate and the BIS faculty adviser that will be evaluated by a committee approved by the BIS faculty.

**RESEARCH EXPERIENCE**

In a number of courses, especially Statistical Consulting (BIS 678a), students gain actual experience with various aspects of research including preparation of a research grant, questionnaire design, preparation of a database for analysis, and analysis and interpretation of real data. In addition, doctoral students can gain research experience by working with faculty members on ongoing research studies prior to initiating dissertation research, which includes but is not limited to BIS 695c. During the summer following the first year of course work, candidates are required to take a research rotation that is approved by the department and communicated to the DGS.

## THE DISSERTATION

The department strives for doctoral dissertations that have a strong methodological component motivated by an important health question. Hence, the dissertation should include a methodological advance or a substantial modification of an existing method motivated by a set of data collected to address an important health question. The dissertation must also include the application of the proposed methodology to real data. A fairly routine application of widely available statistical methodology is not acceptable as a dissertation topic. Candidates are expected not only to show a thorough knowledge of the posed health question, but also to demonstrate quantitative skills necessary for the creation and application of novel statistical tools.

### *Chronic Disease Epidemiology*

Epidemiology is the study of disease in populations. Such populations may be groups of people in certain geographic areas, people with a common disease, or people with some suspected risk factor. The Department of Chronic Disease Epidemiology (CDE) has traditionally focused on either chronic or noninfectious diseases, although in recent years the artificiality of this distinction has become obvious and the view has been broadened. A recent thesis, for example concerned the perinatal transmission of HIV/AIDS, and others have examined the viral etiology of cancer.

The department is perhaps best known for its doctoral programs in the epidemiology of aging, cancer, perinatal diseases, genomics, HIV/AIDS, and psychosocial disorders. However, students in the department often work on projects with other departments within YSPH, other departments in the School of Medicine, and other schools within the University. Thus there are numerous opportunities for creating an experientially rich doctoral program.

Graduates from the department's doctoral program are found on the faculties of universities throughout the world, at the highest levels of federal and international research programs, and in leadership positions in numerous private and public foundations and institutions.

## REQUIRED COURSE WORK

Students in the CDE department are expected to complete a minimum of fifteen courses from the following courses or their equivalents. Students may choose the traditional Epidemiology concentration or the Social and Behavioral Sciences concentration as noted below. Students must declare their concentration by the end of the first year with approval from their academic adviser. Students supported by training grants may be subject to additional requirements and should discuss whether there are training-specific requirements with the principal investigator of the grant.

### **Epidemiology concentration**

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
CDE/EHS 502b	Physiology for Public Health	1
CDE/EMD 508a	Principles of Epidemiology I	1
CDE 516b	Principles of Epidemiology II	1
CDE 523b	Measurement Issues in Chronic Disease Epidemiology	1

CDE 534b	Applied Analytic Methods in Epidemiology	1
CDE 610b	Applied Area Readings for Qualifying Exams	n/a
CDE 617b	Developing a Research Proposal	1
CDE 619a	Advanced Epidemiologic Research Methods	1
CDE 634b	Advanced Applied Analytic Methods in Epidemiology and Public Health	1
CDE 650a	Introduction to Evidence-Based Medicine and Health Care	1

In consultation with their dissertation adviser, students choose three 600-level course units in Biostatistics as well as three additional electives that will best prepare them for their dissertation research.

**Social and Behavioral Sciences concentration**

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
CDE/EMD 508a	Principles of Epidemiology I	1
CDE 516b	Principles of Epidemiology II	1
CDE 534b	Applied Analytic Methods in Epidemiology	1
CDE 573a	Social and Cultural Factors in Mental Health and Illness	1
CDE 574b	Developing a Health Promotion and Diseases Prevention Intervention	1
CDE 610b	Applied Area Readings for Qualifying Exams	n/a
CDE 617b	Developing a Research Proposal	1
CDE 634b	Advanced Applied Analytic Methods in Epidemiology and Public Health	1
CDE 650a	Introduction to Evidence-Based Medicine and Health Care	1
CDE 676b	Questionnaire Development	1

In consultation with their dissertation adviser, students choose three 600-level course units in Biostatistics as well as three additional electives that will best prepare them for their dissertation research.

**QUALIFYING EXAMINATION**

The qualifying examinations in CDE entail a three-part system emphasizing biostatistics, epidemiologic methods, and the student’s chosen specialty area.

The examination covering epidemiological methods includes both an in-class and a take-home portion. One faculty member is responsible for coordinating this examination, and the examination content is developed by the overall faculty. The specialty area examination is usually prepared in a tutorial with one or more faculty members in the term prior to the exam.

**RESEARCH EXPERIENCE**

In a number of courses, students gain actual experience with various aspects of research including preparation of a research grant, questionnaire design, preparation of a database for analysis, and analysis and interpretation of real data. In addition, doctoral students

can gain research experience by working with faculty members on ongoing research studies prior to initiating dissertation research.

## THE DISSERTATION

For the doctoral dissertation, some candidates will design and develop their own research protocol, collect the data, and conduct appropriate analyses. However, epidemiologic studies are often large, time-consuming, and expensive enterprises that often cannot be realistically completed within the time frame expected for a doctoral dissertation. Consequently, some dissertations often result from “piggy-backing” the dissertation research onto a larger study being conducted by a faculty member. If a student has previously documented experience with data collection, the doctoral dissertation may emphasize the statistical analysis of a data set in such a way as to address a new hypothesis. However the thesis is constructed, the department requires that the research makes a significant contribution to new knowledge in the field of epidemiology. Many dissertations are presented as three or more completed, submitted, or published manuscripts based on the dissertation research.

## *Environmental Health Sciences*

The Environmental Health Sciences (EHS) doctoral program focuses on how environmental agents—physical, chemical, and biological—affect human health, considered within the general framework of epidemiology and public health. Students are skilled in research, assessment, and evaluation of the impact of environmental stressors; they identify potentially adverse environmental agents, assess their exposures, determine their impact on health, and estimate the consequent risk. The Ph.D. emphasizes the preparation of students for scholarly careers in research and teaching.

## REQUIRED COURSE WORK

The student’s academic adviser determines which core background requirements have been satisfied by previous course work, and which courses the student has to complete successfully. Subsequently, the student and his/her academic adviser form a plan for the student’s course work.

Students typically complete the following course requirements:

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
BIS 505a	Introduction to Statistical Thinking I	1
BIS 505b	Introduction to Statistical Thinking II	1
CDE/EMD 508a	Principles of Epidemiology I	1
EHS/CDE 502b	Physiology for Public Health	1
EHS 503a	Introduction to Toxicology	1
EHS 507a	Environmental Epidemiology	1
EHS 508b	Assessing Exposures to Environmental Stressors	1
EHS 610b	Applied Area Readings for Qualifying Exams	n/a

In addition to the above required courses, students elect six courses from the more specialized areas of environmental health (occupational health, risk assessment, etc.). Students supported by training grants may be subject to additional requirements and should

discuss whether there are training-specific requirements with the principal investigator of the grant.

The courses listed below are strongly encouraged for students who select Environmental Epidemiology as their area of specialization. In consultation with the student's adviser, alternate courses may be selected.

BIS 623a	Applied Regression Analysis	1
BIS 625a	Categorical Data Analysis	1
CDE 516b	Principles of Epidemiology II	1
CDE 617b	Developing a Research Proposal	1
EHS 545b	Molecular Epidemiology	1
EHS 580b	Environmental Hormones and Human Health	1

Students who select specialization in an area other than Environmental Epidemiology will, together with the academic adviser, identify the specialization area and determine the selection of courses required. These courses may come from other graduate programs in YSPH, as well as from programs in other parts of the University. Students are particularly encouraged to seek additional courses in such subjects as chemistry, cellular and molecular physiology, engineering, forestry, medicine, pharmacology, and physics.

#### QUALIFYING EXAMINATION

The qualifying examination in EHS tests the student's knowledge in three areas – a specialty and two other areas based upon the student's specialty. The majority of students select Environmental Epidemiology as their area of specialization, and then have Biostatistics as an additional area covered in the comprehensive examinations. Preparation for the specialty area examination usually takes place in a tutorial with one or more faculty members in the term prior to the exam. Specialization in other basic biomedical sciences or departments of the University is also possible.

#### RESEARCH REQUIREMENTS

During the second term of the first year and the first term of the second year, students work with their academic adviser to participate in ongoing research activities, thereby gaining an opportunity to learn hands-on techniques in subject areas within environmental health sciences.

#### THE DISSERTATION

The dissertation for the Ph.D. degree must make an original contribution to the field.

#### *Epidemiology of Microbial Diseases*

The goals for doctoral students in the department of Epidemiology of Microbial Diseases (EMD) are to obtain a current theoretical and practical base of epidemiological and microbiological principles, to master research methods, and to apply these skills to investigations of the biology of infectious organisms of public health importance, their transmission, and the epidemiology of the diseases they cause. The approach is multidisciplinary. It includes in-depth ecological, pathogenic, clinical, cellular, immunological, and molecular aspects of infectious diseases, their causative agents, vertebrate hosts, and vectors.

**REQUIRED COURSE WORK**

Courses in biostatistics, epidemiology, and microbiology are strongly recommended. The specific courses recommended depend on the background of individual students and their stated research interests. An individual program that includes courses, seminars, and laboratory rotations is developed by the student and his or her academic adviser. All students are required to complete three distinct research rotations. These are done in the fall and spring terms and in the summer between the first and second years. Students will be asked to prepare a brief presentation at the end of each rotation. These research rotations (EMD 670) are graded and account for three of the required ten courses. Student progress is reviewed at the end of each academic year.

The following courses are suggested courses that are appropriate for Ph.D. students in EMD. However, other courses in YSPH or in other departments may also be appropriate.

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
*CBIO 602a	Molecular Cell Biology	1
CDE/EMD 508a	Principles of Epidemiology I	1
CDE 516b	Principles of Epidemiology II	1
EMD 512b	Immunology for Epidemiologists	1
EMD 538a	Quantitative Methods for Infectious Disease Epidemiology	1
EMD 539b	Introduction to Public Health Surveillance	1
EMD/CDE 543a	Global Aspects of Food and Nutrition	1
EMD 547b	Vaccines: Concepts in Biology	1
EMD 548b	Observing Earth from Space	1
EMD 550b/682b	Biology of Insect Disease Vectors	1
EMD 567a	Tackling the Big Three: Malaria, TB, and HIV in Resource-Limited Settings	1
EMD 680a	Advanced Topics in Tropical Parasitic Diseases	1
†F&ES 500a	Landscape Ecology	1
*GENE 734a	Molecular Biology of Animal Viruses	1
HPM 570a	Cost-Effectiveness Analysis and Decision Making	1
*PATH 650b	Cellular and Molecular Biology of Cancer	1

\*These courses are offered in the School of Medicine.

†This course is offered in the School of Forestry & Environmental Studies.

**RESEARCH REQUIREMENTS**

Three research training modules are required of all students, and each term involves a different investigator. These are offered as formal courses, and there will be a brief presentation to the department at the end of each rotation. Each term is graded and recorded on the student's transcript. Investigators act as tutors and monitor the progress of the work, although students are given a certain amount of independence in their work. Rotations are defined broadly, including experiments in the more traditional wet laboratory setting, as well as work in the field and on the computer.

## QUALIFYING EXAMINATION

EMD has adopted an oral and written qualifying examination format. The qualifying examination serves as an opportunity for the faculty to evaluate students before their admission to candidacy for the Ph.D. degree. It also serves as a valuable learning experience, where a student has a chance to read critically and in-depth with various faculty members on both the thesis topic and two other topics of interest to the student. The other two topics should ideally be in areas which will expand the dissertation topic to subject matters not covered in the courses. The second component includes writing a research proposal on the proposed dissertation topic. The oral examination takes the form of questions from members of the committee based on the readings and an oral defense of the research proposal.

Detailed information regarding the EMD qualifying examination is available from the EMD representative to the GSEC or the coordinator of graduate student affairs.

### *Health Policy and Management*

The doctoral program in the Department of Health Policy and Management (HPM) is designed to educate individuals to apply knowledge derived from public health and social sciences (biostatistics, epidemiology, political science, organizational behavior and theory, and microeconomics) and to creatively extend such knowledge. Individuals with advanced training in health services research, management, and health policy analysis prepare for research, teaching, or policy careers in both the public and the private sector. The program seeks to educate individuals to engage in activities on the forefront of (1) health services research, (2) organizational theory and management, (3) policy formulation and analysis, and (4) economic theory and its application to health programs.

## COURSE WORK

Students in HPM become prepared for their qualifying examinations in the areas of (1) health policy and management, (2) methods and statistics, and (3) an area of depth; students will choose one of three areas of depth – Economic Theory and Application; Organizational Theory and Management; or Political and Policy Analysis.

Faculty advisers and students will seek to select doctoral-level graduate courses for all course work. In cases where the course approved is a master's-level course, HPM faculty will work with instructors to ensure that students are receiving extra doctoral-level content and assignments. This may include different assignments, research papers, additional readings, or other methods to ensure the course provides doctoral-level education. Responsibility for ensuring that this occurs lies with the student and his or her primary adviser, although the adviser will only facilitate the process, not take on responsibility for teaching the material.

Students will complete the following course work or the equivalent of the topic areas covered in these courses. This course listing represents a suggested program of study. With the approval of the academic adviser and DGS, alternative courses that better suit the needs of the student may satisfy the course work requirement. The departmental representative to the GSEC in conjunction with the student's adviser is responsible for determining if core course requirements have been satisfied by previous course work

or alternative courses. If so, the student should apply for a course waiver through the Graduate School. HPM students can only waive up to two courses.

**Biostatistics/Statistics and Methods** (minimum of 4 courses)

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
BIS 623a	Applied Regression Analysis	1
BIS 625a	Categorical Data Analysis	1
BIS 628b	Longitudinal and Multilevel Data Analysis	1
CDE 580b	Qualitative Research Methods in Public Health	1
*ECON 558a	Econometrics	1
HPM 583b	Methods in Health Services Research	1
*PLSC 500a	Statistics	1
*PLSC 503b	Quantitative Methods	1
*PLSC 504a	Advanced Quantitative Methods	1
*PLSC 508b	Causal Inference and Research Design	1
*SOCY 578a	Logic of Empirical Social Research	1
*SOCY 580a	Introduction to Methods in Quantitative Sociology	1
*SOCY 581b	Intermediate Methods in Quantitative Sociology	1
*SOCY 582a	Statistics III: Advanced Quantitative Analysis for Social Scientists	1

**Health Policy and Management** (minimum of 4 courses, all with Ph.D. readings)

HPM 510a	Introduction to Health Policy and Health Systems	1
HPM 514b	Health Politics, Governance, and Policy	1
HPM 560b	Health Economics and U.S. Health Policy	1
HPM 561b	Managing Health Care Organizations	1
HPM 570a	Cost-Effectiveness Analysis and Decision Making	1
HPM 587a	Health Care Economics	1
HPM 590b	Addiction, Economics, and Public Policy	1
HPM 597b	Capstone Course in Health Policy	1
†HPM 617a and b	Colloquium in Health Services Research	n/a
‡MGT 879b	Health Care Operations	1

**Individualized readings** (required)

HPM 610b	Applied Area Readings for Qualifying Exams	n/a
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†HPM 617 is required of all Ph.D. students but does not count toward the total number of required courses.

‡This course is offered in the School of Management.

**AREAS OF DEPTH**

Students will take a minimum of four courses relevant to the area of depth chosen.

All students supported by the National Institute on Drug Abuse (NIDA) training program must take one to two courses in substance abuse, behavioral economics, or psychiatric/mental health issues; these may be classes already counted toward other Ph.D. requirements.

Students supported by training grants may be subject to additional requirements and should discuss whether there are training-specific requirements with the Principal Investigator of the grant.

In Economic Theory and Application, students may count ECON 558a as either a statistics/methods class or as an area of depth class, but not both.

**Required courses in Economic Theory and Application**

*ECON 545a	Microeconomics	1
*ECON 558a	Econometrics	1

In addition, students take two field courses in a concentration area in which they plan to develop expertise. Sets of courses across topics can be selected to meet research interests. Concentration areas are:

*Behavioral Economics*

*ECON 529b	Behavioral and Neuro-economics	1
*ECON 740b	Experimental Economics Seminar	1
*MGMT 758b	Foundations of Behavioral Economics	1

*Labor Economics*

*ECON 630a	Labor Economics	1
*ECON 631b	Labor Economics	1
*ECON 776b	Economics of Population	1

*Public Finance*

*ECON 680a	Public Finance I	1
*ECON 681b	Public Finance II	1

*Economic Development*

*ECON 730a	Economic Development I	1
*ECON 731b	Economic Development II	1
*ECON 776b	Economics of Population	1
*ECON 797b	Institutions, Politics, and Economic Policy in Developing Countries	1

**Required courses in Organizational Theory and Management**

*MGMT 730a	Organizations and Management Workshop	1
*MGMT 731b	Organizations and the Environment	1

In addition, students take two courses in the field, selected in consultation with adviser.

**Required courses in Political and Policy Analysis**

Four courses are required, selected in consultation with adviser. Suggested courses are:

*AMST 685b	Disability: Representation, History, Ethics	1
*ANTH 583b	Health Disparities and Health Equity: Biocultural Perspectives	1
*PLSC 800a	Introduction to American Politics	1
*PLSC 801a	Political Preferences and American Political Behavior	1
*PLSC 802b	Collective Action and Choice	1
*PSYC 647b	Social Science and Institutional Design	1
*SOCY 557b	Political Sociology	1

\*These courses are offered in the Graduate School of Arts and Sciences.

## QUALIFYING EXAMS

Students will take three qualifying exams, each of which will be graded by two faculty members.

The HPM exam will be written by HPM faculty and will draw on the HPM courses taken by the student.

The methods and statistics exam will be written by faculty to be determined and will reflect the statistics and methods classes taken.

The area of depth exam will be written by HPM faculty with expertise in that area and should reflect the minimum of four courses taken in that area.

## RESEARCH REQUIREMENTS

All students are expected to develop their research skills through interaction with HPM faculty around ongoing faculty research.

## M.D./PH.D. PROGRAM REQUIREMENTS

All M.D./Ph.D. students must meet with the director of graduate studies in Public Health if they are considering affiliating with PH. Students in this program are expected to meet the guidelines listed below in the time frame outlined. The DGS must approve any variations to these requirements.

### *Teaching*

One term of teaching as a TF 2 (10 hours/week) will be required. If students teach beyond this requirement, they can be compensated. If a student has served as a teaching assistant elsewhere on campus, this experience may be counted toward the requirement.

### *Rotations/Internships*

Students should do two rotations/internships with potential advisers in YSPH. These short-term research projects can be either in a lab or working with a specific faculty member. The purpose of these rotations/internships is to learn lab technique and/or to allow the student time to determine if the faculty member's research directions are compatible with his/her research interests. These rotations/internships are usually done during the summer between the first and second year of School of Medicine course work. In some cases students may need to defer this until the summer after the second year after taking certain courses and/or completing readings so that they possess the background necessary for a successful rotation/internship.

### *Required Course Work*

M.D./Ph.D. students are generally expected to take the same courses as traditional Ph.D. students. Departmental requirements may vary; therefore, students should confer with the DGS and/or their Ph.D. adviser.

### *Timeline for Qualifying Exam*

Students generally will take School of Medicine courses in years one and two, then PH doctoral course work in years three and four (all or part of year three). The qualifying exam is generally taken in the summer following the fourth year.

### *Prospectus Timeline*

Students are encouraged to develop their prospectus during their third and fourth years of study, while taking courses in YSPH. Upon completion of the qualifying exam, students should focus entirely on completion of the prospectus, which should be submitted no later than six months after the completion of the qualifying exams.