

STUDENT HANDBOOK

GUIDELINES FOR GRADUATE STUDY

Version 2017.2 (August 25, 2017)

Graduate Programs in Human Genetics

Department of Human Genetics

Graduate School of Public Health

University of Pittsburgh

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DEGREE PROGRAMS

The Department of Human Genetics offers the following programs:

Ph.D. in Human Genetics (including genetic counseling emphasis),
M.S. in Human Genetics,
M.S. in Genetic Counseling,
M.P.H. in Public Health Genetics,
Dual M.S. in Genetic Counseling and M.P.H. in Public Health Genetics,
M.D./Ph.D. in Human Genetics (in collaboration with the MSTP program),
Certificate (non-degree) program in Public Health Genetics.

Requirements for each program are described in detail below. This document primarily presents requirements that are specific to the Department of Human Genetics. Students should consult the Graduate and Professional Bulletin of the University of Pittsburgh and the regulations of the Graduate School of Public Health for more general requirements.

CONTACT INFORMATION

For all inquiries, please contact

Noel Harrie, Student Service Coordinator

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Graduate School of Public Health
Department of Human Genetics
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APPLICABILITY

As there have been some adjustments in course requirements, the course requirements described here formally apply only to students starting our program after the date of this version of the Student Handbook. Older versions of the Student Handbook are available on the Human Genetics web page, and each student is governed by the course requirements of the Student Handbook in effect when they first started our program. However, where the current course requirements have added courses, we strongly encourage our students to take these additional courses if feasible.

PH.D. IN HUMAN GENETICS

Admission

Application for admission must be made through the Graduate School of Public Health Office of Student Affairs. Applications are accepted at any time, although it is preferable to start the program in the Fall semester. Applicants who wish to be considered for financial aid must apply by December to be considered for admission and aid the following Fall. For specific deadlines in any given year, refer to the Pitt Public Health Office of Student Affairs information.

Admission requires a bachelor's degree in a discipline related to the biological, behavioral, or mathematical sciences from an accredited college or university, with a grade point average of 3.0. Prerequisites to admission to the program are a first course in genetics and calculus. Graduate Record Examination (GRE) scores must be supplied by all applicants and should be above the 70th percentile. Subject GREs are not required. Students seeking a Ph.D. may apply directly to the Ph.D. program regardless of whether they already have a Master's degree. Students in good standing in the M.S. degree program within the Department of Human Genetics may apply to the Ph.D. degree program at any time, but can only be considered for financial aid once per year along with new Ph.D. applicants. All applications are evaluated by the faculty on the basis of undergraduate academic performance, experience, personal statement, letters of recommendation, and scores on the GRE and TOEFL (for those for whom English is a second language). For foreign students, the University of Pittsburgh requires an official score report from the TOEFL or the IELTS exam. The minimum acceptable TOEFL score is either 550 on the written test or 80 on the Internet test. The minimum acceptable score on the IELTS is Band 6.5, and applicants must take the academic writing and reading modules of the test. The TOEFL or IELTS must be taken within two years prior to the application for admission.

Applicants who are graduates of an accredited college or university but who do not qualify for admission to full graduate status because of deficiencies in either their undergraduate course program or their scholastic achievement, may be considered for provisional graduate status if there is strong supporting evidence of their ability to successfully complete a graduate program. Courses taken to remove deficiencies do not count toward completion of graduate degree requirements. Transfer from provisional to full graduate status is initiated and recommended by the department, and is possible only after removal of deficiencies and other conditions noted at the time of admission and satisfactory progress in graduate course work.

A Ph.D. in human genetics with a focus on genetic counseling is available. This focus is intended for genetic counselors who wish to obtain an advanced degree beyond the Master's degree and target their careers on pursuits that will be enhanced by a Ph.D. degree. Individuals who are accepted to or have completed the University of Pittsburgh Genetic Counseling Program can apply to this focus within the Ph.D. program. In addition, individuals who have successfully completed a genetic counseling program accredited by the Accreditation Council of Genetic Counseling are eligible to apply. Developing a dissertation project that contributes to the genetic counseling discourses is encouraged within this focus.

Admission: current graduate students

If you are a current M.S. or M.P.H. student in the Graduate School of Public Health, and would like to apply to our Ph.D. program, the application process is relatively simple because, as an internal applicant, we already have access to your previous application record and current academic record here at the University of Pittsburgh. Please submit the following to the Office of Student Affairs:

- A) An updated 'Statement of Purpose and Objectives', explaining your motivation and reasons for applying to the Ph.D. program. Please let us know if you have already found a mentor with whom you will pursue your doctoral research.
- B) Two local letters of recommendation, from mentors/professors who are familiar with your recent academic and research performance. If you want to submit more than two, that is fine, but not required.

Please let Dr. Shaffer (john.r.shaffer@pitt.edu) and Noel Harrie (nce1@pitt.edu) know when these items have been submitted.

Financial Aid

Graduate Student Researcher (GSR) positions, provide both tuition and stipend support. Most full-time students in the Ph.D. program eventually earn financial support as a GSR. Admission to the program does not guarantee financial aid, however. For students who are admitted with a departmental financial aid offer, the department pays both tuition and stipend during the first year of the Ph.D. program. Students who are admitted but not offered departmental aid may seek GSR positions with individual faculty as an alternative. After the first year, the department continues to support tuition for all Ph.D. students with GSRs, and stipends are supported by the student's research advisor. Continuation of GSR support is based on satisfactory performance as described in the Pitt Public Health Policy for Graduate Student Researchers.

Students who have questions about the University's policy on sufficient academic progress for student loans should speak with the Assistant Dean for Student Affairs.

Overview

The Ph.D. Program is comprised of a combination of course work and original research, which usually allows attainment of the degree within 4-5 years. The University requires the minimum elapsed residence time for the Ph.D. degree to be six terms of full-time graduate study. General requirements are listed below, but the student should also consult with his/her academic advisor.

Important: Please also read the ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS section on page 33.

Program Objectives

Students successfully completing this program will be able to:

- Describe basic genetic mechanisms and how they affect proteins, chromosomes, cells, individuals, and populations of organisms in normal and disease states.
- Describe mechanisms by which genes and the environment interact to affect the distribution of health and disease in human populations.
- Demonstrate familiarity with a broad range of molecular, clinical, and analytical methodologies for genetic studies, and demonstrate mastery of a substantial subset of methods.
- Analyze published research in human genetics at the level needed for effective research and teaching.
- Use their in-depth experience with a specific research project in genetics to generate and test research hypotheses, design experiments, analyze data, and interpret research results.
- Communicate their own research ideas and results, orally and in publishable written form.
- Apply fundamental principles of grant-writing.
- Apply fundamental principles of laboratory and research program management, and of ethical research practice.

Coursework

A minimum total of 72 credits is required. Students are required to obtain a grade of “C” or better for all of the Human Genetics and extra-departmental *core* courses listed below. Students are allowed two attempts to obtain a “C” grade in a core course. The following courses are required:

Human Genetics professional and scientific skills courses:

HUGEN 2010	Bioinformatic Resources for Geneticists	1 credit
HUGEN 2011	Scientific Writing for Human Genetics	1 credit
HUGEN 2025	Human Genetics Seminar (must be taken four times)	0 credits
HUGEN 2028	Human Genetics Journal Club and Peer Review	1 credit

Human Genetics core courses:

HUGEN 2022	Human Population Genetics	2 credits
HUGEN 2031	Chromosomes and Human Disease	3 credits
HUGEN 2034	Biochemical and Molecular Genetics of Complex Disease	3 credits
HUGEN 2040	Molecular Basis of Human Inherited Disease	3 credits

Extra-departmental core courses:

BIOST 2041	Introduction to Statistical Methods 1	3 credits
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BIOST 2042	Introduction to Statistical Methods 2	3 credits
EPIDEM 2110	Principles of Epidemiology	3 credits
PUBHLT 2011	Essentials of Public Health	3 credits
PUBHLT 2022	The Dean's Public Health Grand Rounds (must be taken for the first two semesters)	0 credits
PUBHLT 2030	Research Ethics	1 credit

Human Genetics research credits, under one or both of the following course designations:

HUGEN 2021	Special Studies	variable
HUGEN 3010	Research and Dissertation	variable

In addition, two advanced courses are required, one of which must be HUGEN 2029.

Advanced Human Genetics courses

HUGEN 2029	Introduction to Gene Mapping	3 credits
HUGEN 2051	Inborn Errors of Development	2 credits
HUGEN 2070	Bioinformatics for Human Genetics	3 credits
HUGEN 2080	Statistical Genetics	3 credits

Students may select another advanced course with permission of the Graduate Director.

Ph.D. students must also make at least one journal club presentation in HUGEN 2028 during the course of their degree program.

Summer Research in Progress Seminar (SRIP): During the summer, the Department organizes a Summer Research in Progress Seminar series, where Ph.D. students give talks describing their research. This provides an opportunity to practice and develop scientific presentation skills, as well as receive helpful feedback in a supportive environment. Ph.D. students are required to attend at least 50% of the seminars for 3 years and present at least twice during the course of their degree program.

Course Schedule for Ph.D. students: The exact schedule of coursework will vary depending on the student's interests, skills, and knowledge. However, the following schedule is a typical sequence for most Ph.D. students for the first two years.

Fall Term of 1st year

BIOST 2041	Introduction to Statistical Methods 1	3 credits
EPIDEM 2110	Principles of Epidemiology	3 credits
PUBHLT 2022	The Dean's Public Health Grand Rounds	0 credits
HUGEN 2040	Molecular Basis of Human Inherited Disease	3 credits
HUGEN 2010	Bioinformatic Resources for Geneticists	1 credit
HUGEN 2022	Human Population Genetics	2 credits
HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2021	Special Studies	3 credits
	or another course	
		<hr/> 15 credits

Spring Term of 1st year

BIOST 2042	Introduction to Statistical Methods 2	3 credits
PUBHLT 2022	The Dean's Public Health Grand Rounds	0 credits
HUGEN 2034	Biochemical Genetics of Complex Disease	3 credits
HUGEN 2031	Chromosomes and Human Disease	3 credits
HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2028	J Club and peer review	1 credit
PUBHLT 2011	Essentials of Public Health	3 credits
HUGEN 2021	Special Studies	2 credits
	or another course	
		<hr/> 15 credits

Summer Term of 1st year

Summer Research in Progress

Fall Term of 2nd year

PUBHLT 2030	Research Ethics	1 credit
HUGEN 2011	Scientific Writing in Human Genetics	1 credit
HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2039	Intro to Gene Mapping*	2 credits
HUGEN 2070	Bioinformatics for Human Genetics*	3 credits
HUGEN 2021	Special Studies	8 credits
	Or other advanced courses	
		<hr/> 15 credits

Spring Term of 2nd year

HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2051	Inborn Errors of Development*	2 credits
HUGEN 2080	Statistical Genetics*	3 credits
HUGEN 2021	Special Studies	10 credits
	Or other advanced courses	
		<hr/> 15 credits

Summer Term of 2nd year

Summer Research in Progress

* courses offered in alternate years

In addition to the courses listed above, students are expected to select, in consultation with their advisor, additional courses appropriate for their areas of concentration. A student's committee may require that a student register for specific courses within or outside the Department of Human Genetics to gain knowledge in an area relevant to the student's area of concentration. It is strongly recommended that entering graduate students who are not fluent in English take a University course in conversational English, which will not contribute to the student's GPA for the Graduate Program.

Upon successful completion of 72 credits and all required courses (possibly including transfer credit from previous graduate work), Ph.D. students should register for Full-time Dissertation Research (FTDR 3999), which carries no credits or letter grade but provides full-time status. It is not necessary to have passed milestone exams in order to register for FTDR.

First Year Research Rotations and Choice of Major Advisor

When the student enters the program, the Director of Graduate Studies is the faculty advisor and will follow the student's progress through the first year. After the first year, the faculty research advisor will oversee the student's research program (see below). However, the Director of Graduate Studies will continue to monitor the student's overall progress throughout the student's tenure in the program.

During the first year of the Ph.D. program, each student is expected to interview faculty members regarding possible research and dissertation areas. Most students participate in research rotations with 1 - 3 prospective advisors during this time. By the end of the first year, the student should choose a research advisor who will give assistance on the choice of a dissertation topic and who will remain in close consultation with the student about various aspects of the research as it progresses. This faculty member also typically provides GSR support for the student, although it is permissible for the student to be supported by a different faculty member than the primary research advisor. The student must submit to the Department written notification of the choice of a faculty research advisor. Exceptions to the procedures described above may be allowed for those students who have previously arranged to work with and be supported by a specific faculty member.

Students may select a faculty research advisor from among the entire faculty of the University of Pittsburgh, provided the advisor is a member of the Graduate Faculty of the university and his/her research involves genetics in some way. It is highly recommended that students first consider faculty within the Department of Human Genetics, then consider faculty with secondary appointments in Human Genetics, and only then go entirely outside the department. If the research advisor does not have a primary appointment in the Department of Human Genetics, the student must also select an academic advisor within the department. In this case the research advisor and the academic advisor typically both provide close guidance to the student throughout his or her tenure in the program.

Ph.D. Qualifying Examination

The purpose of the Qualifying Examination is to assess the breadth of the student's knowledge of the discipline, the student's achievement during the first year of graduate study, and the student's potential to apply research methods independently. This judgment will be based on the student's aptitude and potential for completing the program as well as on his or her mastery of the desired substantive content to date. The Qualifying Examination is an oral examination in which the student presents a critical analysis of a published paper from the contemporary peer-reviewed literature. For full-time students the examination is usually taken during the second year in the Ph.D. program, preferably in the Spring or Summer term.

It is the student's responsibility to (1) initiate the appointment of a Qualifying Examination Committee, (2) arrange a date for the examination, and (3) inform Ms. Noel Harrie, the student liaison in the Department of Human Genetics, and she will check the graduate status of the committee members and arrange a room. If the student has separate research and academic advisors, both normally serve on the qualifying exam committee. The committee must be approved by the Office of Student Affairs; this approval will be requested in a letter (or email) prepared by the Department of Human Genetics student services staff and signed by the student's program director or advisor.

Rules for Ph.D. Qualifying Examination Committee membership:

- The committee must consist of at least four University of Pittsburgh faculty members.
- The committee chair and at least one other member must be on the core faculty list of the Human Genetics Department.
- Half or more of the members must be on the core faculty list of at least one Pitt Public Health department.
- Half or more of the members must have graduate faculty status.
- One of the Pitt faculty on the committee must not be on the core list of the Human Genetics Department.

The Pitt Public Health Office of Student Affairs maintains a list of the core educational faculty of each department. Students should contact Noel Harrie (nce1@pitt.edu) for the current list. Core educational faculty of the Human Genetics Department are indicated on the departmental website (<http://publichealth.pitt.edu/human-genetics/academics/student-handbooks-forms>).

The chair of the Qualifying Examination committee (who must be a primary faculty member in the Department of Human Genetics), in consultation with the other committee members, selects the paper on which the oral examination is based. This paper should be 'new' to the student: the student must not have presented this paper nor may others have presented it recently. The paper should also fall outside of the student's primary thesis area. One week prior to the examination date, the paper is distributed to the student and the committee. During the week in which the student is studying the assigned paper he or she may consult with committee members on background scientific issues, but should not receive direct help in interpreting the paper. He or she should not consult with anyone outside the committee on any issue relevant to the paper. At the examination, the student presents a critical review of the background and hypothesis of the paper, the methods, results and conclusions of the paper. The presentation is typically 30 - 50 minutes long. The student should be able to critically judge the methods used, the data and its analysis, and the conclusions drawn from these analyses. The student is expected to be able to identify weaknesses in the paper, judge the validity of the conclusions, and suggest alternative ways to test the hypothesis posed. The student will also be asked to answer questions on general background and course material relevant to the degree. Example papers and questions are available in the Qualifying Exam Study Guide on the departmental website to assist students in preparing for the Qualifying Examination (<http://publichealth.pitt.edu/human-genetics/academics/student-handbooks-forms>).

Passing of a candidate in the Qualifying Examination is by a unanimous vote of the committee. The committee's decision is reported to the department chair, who forwards it to the Office of

Student Affairs. A student who fails to pass may repeat the Qualifying Examination one time, preferably within 4-8 weeks after the failed attempt (see Pitt Public Health Policy on Probation and Dismissal).

Comprehensive Examination and Dissertation Overview

Students enrolled in the Ph.D. program should take the Ph.D. Comprehensive Examination within two years after passing the Qualifying Examination. The Comprehensive Examination is generally administered after the student has completed his/her coursework and has decided on a dissertation topic. The student is responsible for initiating the appointment of a Comprehensive Examination Committee and arranging a date for the examination. The student's advisor, with the concurrence of the department chair, recommends the committee membership for approval to the Office of Student Affairs. The function of this committee is to administer the examination. The Comprehensive Examination committee is typically chaired by the student's research advisor, and goes on to become the student's Dissertation Committee. Note that the committee chair need not have a primary appointment in the Department of Human Genetics.

Rules for Ph.D. Comprehensive Committee membership are identical to the rules for the Ph.D. Dissertation Committee membership (see below).

For the Comprehensive Examination, the student is required to complete a dissertation research proposal. The dissertation proposal should provide the basis for an open discussion to determine whether the student has a good project and how it can be improved. Potential and/or perceived flaws or uncertainties should be clearly discussed and highlighted. The topic of the proposal is generally selected by the student in consultation with his or her research advisor. The proposal is expected to be conceptually well-founded and adequately documented. Attribution to published and unpublished sources must be comprehensive. As described in the Appendix on page 37, the proposal is to be well-organized and should describe original and innovative experiments or analyses that will accomplish the stated aims and objectives of the research. The written proposal must include the rationale as well as the significance of the proposed experiments or analyses. The significance of the expected results should be discussed. There is no absolute limit on the length of the proposal, but it is recommended that the entire document be no more than 10 to 20 double-spaced pages of text and up to an additional 10 pages of references, appendices, tables, figures, etc. Already-written papers should be included as appendices, but should be summarized in the main body of the proposal. The final written proposal should be delivered to all members of the committee a minimum of three weeks prior to the oral examination date. The committee will then provide feedback on the proposal within two weeks. Students will then have the week before the exam to revise the proposal. The Director of Graduate Studies recommends that all students discuss the Specific Aims of their dissertation research proposal with all members of their Comprehensive Exam committee at least two to three months (or more) before their Comprehensive Exam.

At the oral examination, the student gives a 30 – 45 minute presentation of the dissertation proposal. The Comprehensive Examination committee evaluates the student's proposal and conducts an oral examination on the student's understanding of both the content of the research proposal and the basic concepts underlying the contents. The student is graded pass/fail. A

unanimous vote of the panel decides the grade. The chair of the committee shall notify the department chair of the decision and submit the completed, signed evaluation form. The department chair shall notify the Pitt Public Health Office of Student Affairs of the decision. A "pass" shall be warranted when both of the following conditions are met: (i) the written proposal is considered acceptable as presented, and (ii) the student has performed knowledgeably in defense of the proposal. In the event of a failure, the student shall be given one opportunity to repeat the Comprehensive Examination provided that the modified written proposal is submitted within four months after notification of failure of the first exam. In the event of a second failure, the faculty shall recommend either dismissal of the student from the program or that the student transfer to the M.S. degree program for the completion of his/her training. See the Pitt Public Health Probation and Dismissal Policy for more information.

Ph.D. Dissertation Committee

The primary responsibility of the Ph.D. Dissertation Committee shall be to advise the student in the effective design, conduct and analysis of a research study and to approve a body of original research of sufficient quality to form the basis for the Ph.D. dissertation. The Dissertation Committee shall be proposed by the student and his or her research and academic advisors and must be approved by the Office of Student Affairs.

Rules for Ph.D. Dissertation Committee membership:

- The committee must consist of at least four University of Pittsburgh faculty members, including the student's research and academic advisor(s).
- At least two members must be on the core list of the Human Genetics Department. Adjunct faculty are included on the core faculty list for the Department of Human Genetics; however, there is a limit of one adjunct faculty member per committee
- The majority of members must have graduate faculty status.
- One of the Pitt faculty on the committee must not be on the core list from the student's department.

The student is responsible for organizing meetings of the Dissertation Committee at least annually, and preferably every six months, to review the student's research progress. A simple majority of the Dissertation Committee determines actions of the committee with the exception of final approval of the doctoral thesis.

Dissertation and Final Oral Examination

The student's dissertation must provide evidence of original scholarly research of sufficient quality to be published in a peer reviewed scientific journal. The style and format of the dissertation must conform to the standards set forth in the University's Electronic Thesis and Dissertation (ETD) rules. Subject to the discretion of the Dissertation Committee, the format of the dissertation can be either a traditional single cohesive document, or individual works in the style of publishable (or published) papers. If the format is that of a compendium of papers, the dissertation must also include a substantial introduction and a substantial discussion that tie the body of work together into a cohesive whole. If the papers have numerous co-authors, it is also recommended that each chapter include a description of the student's contribution to the work.

The dissertation advisor and one or more members of the Dissertation Committee may read preliminary drafts of the dissertation, suggest revisions and approve the final copy for submission to the Dissertation Committee.

The student is responsible for scheduling the date and time of the Final Oral Examination (dissertation defense), which cannot take place in the same semester as the comprehensive exam.

To check for inadvertent plagiarism, the student must run the dissertation through iThenticate, revise the dissertation, if needed, in response to the results, and share the iThenticate report on the final version with the dissertation advisor. An iThenticate account can be requested through the Office of Research (<http://www.research.pitt.edu/ithenticate>).

The final copy of the dissertation must be submitted to the Dissertation Committee at least three weeks prior to the Final Oral Examination. With consent of every member of the committee, a shorter time-period may be allowed. It is highly recommended that the defense occur at least two weeks prior to the **initial** dissertation submission deadline for the semester in which the student plans to graduate. The dissertation defense will consist of a public seminar on the subject of the dissertation followed by an examination by the Dissertation Committee. Approval of the dissertation is certified by a unanimous vote of the Dissertation Committee. The degree will be granted by the University of Pittsburgh.

Students intending to graduate must file an application to graduate by the deadline specified in the University Calendar. They must notify the Department of Human Genetics approximately two months prior to the intended date of the dissertation defense, so that public notices of the defense date can be placed according to University policy.

The final copy of the dissertation must be prepared and submitted according to the University guidelines for Electronic Theses and Dissertations (ETD). Detailed information on requirements is available from the Pitt Public Health Office of Student Affairs and at <http://www.pitt.edu/~graduate/etd>.

M.S. IN HUMAN GENETICS

Admission

See “Ph.D. in Human Genetics” above. Admission criteria are the same for M.S. applicants.

Financial Aid

Tuition support is not normally available to students in the M.S. program, although M.S. students may be able to arrange for hourly wage/stipend support from research mentors. Students who have questions about the University’s policy on sufficient academic progress for student loans should speak with the Assistant Dean for Student Affairs.

Overview

The M.S. in Human Genetics is a research-oriented degree, intended to prepare the graduate to participate in laboratory or statistical research or to go on to Ph.D. level study. The requirements for the M.S. in Human Genetics can normally be fulfilled in two years of full-time study. Students interested in pursuing a Ph.D. are encouraged to apply directly to the Ph.D. program; an M.S. is not required for entrance to the Ph.D. program.

General requirements are listed below, but the student should also discuss requirements with his or her faculty advisor.

Important: Please also read the ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS section on page 333.

Program Objectives

Students successfully completing this program will be able to:

- Describe basic genetic mechanisms and how they affect proteins, chromosomes, cells, individuals, and populations of organisms in normal and disease states.
- Describe mechanisms by which genes and the environment interact to affect the distribution of health and disease in human populations.
- Demonstrate familiarity with a range of molecular, clinical, and analytical methodologies for genetic studies, and demonstrate mastery of at least a subset of methods.
- Analyze published research in human genetics.
- Use their in-depth experience with a specific research project in genetics to generate and test research hypotheses, design experiments, analyze data, and interpret research results.
- Summarize and present a research project orally and in writing.

Coursework

A minimum total of 36 credits is required for the M.S. in Human Genetics. Students are required to obtain a grade of “C” or better for all of the Human Genetics and extra-departmental *core* courses listed below. Students are allowed two tries to obtain a “C” grade in a core course. The following courses are required.

<u>Human Genetics professional and scientific skills courses:</u>		
HUGEN 2010	Bioinformatic Resources for Geneticists	1 credit
HUGEN 2011	Scientific Writing for Human Genetics	1 credit
HUGEN 2025	Human Genetics Seminar (must be taken four times)	0 credits
HUGEN 2028	Human Genetics Journal Club and Peer Review	1 credit

Human Genetics core courses:

HUGEN 2022	Human Population Genetics	2 credits
HUGEN 2031	Chromosomes and Human Disease	3 credits
HUGEN 2034	Biochemical and Molecular Genetics of Complex Disease	3 credits
HUGEN 2040	Molecular Basis of Human Inherited Disease	3 credits

Extra-departmental core courses:

BIOST 2041	Introduction to Statistical Methods 1	3 credits
BIOST 2042	Introduction to Statistical Methods 2	3 credits
EPIDEM 2110	Principles of Epidemiology	3 credits
PUBHLT 2011	Essentials of Public Health	3 credits
PUBHLT 2022	The Dean's Public Health Grand Rounds (must be taken for the first two semesters)	0 credits
PUBHLT 2030	Research Ethics	1 credit

Human Genetics research credits:

HUGEN 2021	Special Studies (Research)	2 credits (minimum)
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M.S. students must make at least one journal club presentation during the course of their degree program.

Course Schedule for Ph.D. students: The exact schedule of coursework will vary depending on the student's interests, skills, and knowledge. However, the following schedule is a typical sequence for most Ph.D. students.

Fall Term of 1st year

BIOST 2041	Introduction to Statistical Methods 1	3 credits
EPIDEM 2110	Principles of Epidemiology	3 credits
PUBHLT 2022	The Dean's Public Health Grand Rounds	0 credits
HUGEN 2040	Molecular Basis of Human Inherited Disease	3 credits
HUGEN 2010	Bioinformatic Resources for Geneticists	1 credit
HUGEN 2022	Human Population Genetics	2 credits
HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2021	Special Studies or another course	3 credits
		<hr/> 15 credits

Spring Term of 1st year

BIOST 2042	Introduction to Statistical Methods 1	3 credits
PUBHLT 2022	The Dean's Public Health Grand Rounds	0 credits
HUGEN 2034	Biochemical Genetics of Complex Disease	3 credits
HUGEN 2031	Chromosomes and Human Disease	3 credits
HUGEN 2025	Human Genetics Seminar	0 credits

HUGEN 2028	Journal Club and peer review	1 credit
PUBHLT 2011	Essentials of Public Health	3 credits
HUGEN 2021	Special Studies or another course	2 credits
		<hr/>
		15 credits
<u>Fall Term of 2nd year</u>		
PUBHLT 2030	Research Ethics	1 credit
HUGEN 2011	Scientific Writing in Human Genetics	1 credit
HUGEN 2021	Special Studies Or other courses	3 credits*
		<hr/>
		5 or more credits
<u>Spring Term of 2nd year</u>		
HUGEN 2021	Special Studies Or other courses	1 or credits*
		<hr/>
		1 or more credits

* the number of credits students take in their 2nd year will depend on their academic interests, progress toward completing their research, as well as, scholarship and loan requirements. All University of Pittsburgh students are required to register for at least one credit for the semester that they plan to graduate.

In addition to the courses listed above, students are expected to select, in consultation with their research advisor, additional courses appropriate for their areas of concentration. A student's committee may require that a student register for specific courses within or outside the Department of Human Genetics to gain knowledge in an area relevant to the student's area of concentration. It is strongly recommended that entering graduate students who are not fluent in English take a University course in conversational English, which will not contribute to the student's GPA for the Graduate Program.

First Year Research Rotations and Choice of Research Advisor

The process for M.S. students is essentially the same as that described for the Ph.D. program above, except that M.S. students are encouraged to move through the process of choosing an advisor a bit more quickly so that thesis research can begin before the start of the second year.

Comprehensive Examination

All M.S. students must pass a comprehensive examination covering areas of basic knowledge relevant to human genetics. The M.S. Comprehensive Examination follows the same form as the Ph.D. Qualifying Examination (described above). The M.S. Comprehensive Examination should be taken in the fall or early in the spring of the second year for full-time students. It must be taken at least one month before the last day of the term in which the student plans to graduate. Typically, the Comprehensive Examination Committee is identical or almost identical to the

Thesis Advisory Committee. After the student has contacted members for be on their Comprehensive Examination committee and identified a date for the exam, the student will inform Ms. Noel Harrie, the student liaison in the Department of Human Genetics, and she will verify that the committee members meet the rules for membership and also arrange for a room for the examination. The committee must be approved by the Office of Student Affairs; this approval will be requested in a letter (or email) prepared by the Department of Human Genetics student services staff.

Rules for M.S. Comprehensive Examination Committee membership:

- The committee must consist of at least three University of Pittsburgh faculty members.
- At least one committee member must be non-adjunct faculty on the core faculty list of the Human Genetics Department.
- Half or more of the members must be on the core faculty list of at least one Pitt Public Health department. Adjunct faculty are included on the core faculty list for the Department of Human Genetics; however, there is a limit of one adjunct faculty member per committee
- One of the Pitt faculty members of the committee must not be on the core list of the Human Genetics Department.

Note that if the M.S. student plans to apply to transfer into the Ph.D. program, then it is recommended that the Comprehensive Examination and M.S. Thesis Committees be chosen so they satisfy equivalent Ph.D. committee composition requirements.

M.S. Thesis Advisory Committee

The Thesis Advisory Committee should be selected by the student in consultation with the research advisor. The committee composition requirements are identical to those described above for the M.S. comprehensive examination, with the addition that the student's research and academic advisor(s) must be on the committee, and the advisory committee can be chaired by the student's research advisor, even if that individual does not have a primary appointment in Human Genetics. The Thesis Advisory Committee must be approved by the Office of Student Affairs. It is the responsibility of the Thesis Advisory Committee to guide the student in selecting an appropriate research topic and in the completion of a satisfactory thesis on an original problem in the area of the student's primary interest. The Committee will meet periodically with the student to give advice on the completion of the research project and preparation of the thesis. If the research advisor is not on the core faculty list of Human Genetics, the student must also select an academic advisor within the department. In this case the research advisor and the academic advisor typically both provide close guidance to the student throughout his or her tenure in the program.

M.S. Thesis

The M.S. thesis must demonstrate a mastery of knowledge in the specific topic area and demonstrate the student's ability to articulate a substantive research question and address the question through laboratory or non-laboratory research or through a comprehensive review of the

literature. The style and format of the dissertation must conform to the standards set forth in the University's Electronic Thesis and Dissertation (ETD) rules.

To check for inadvertent plagiarism, the student must run the thesis through iThenticate, revise the thesis, if needed, in response to the results, and share the iThenticate report on the final version with the thesis advisor. An iThenticate account can be requested through the Office of Research (<http://www.research.pitt.edu/ithenticate>).

A final copy of the thesis must be submitted to the Thesis Advisory Committee for evaluation at least one week prior to the oral examination (thesis defense). The Thesis Advisory Committee will judge the adequacy of the thesis by an open oral examination covering the subject of the thesis. Successful completion of the M.S. thesis requires unanimous agreement by the Thesis Advisory Committee.

All M.S. students must register for at least one credit during the term in which they intend to graduate.

Students intending to graduate must file an application to graduate by the deadline specified in the University Calendar.

The final copy of the M.S. thesis must be prepared and submitted according to the University guidelines for Electronic Theses and Dissertations (ETD): <http://www.pitt.edu/~graduate/etd>.

M.S. IN GENETIC COUNSELING

(A Ph.D. in Human Genetics with a focus on genetic counseling is available. Please see the Ph.D. in Human Genetics section for further information.)

Admission

Application for admission must be made through the Graduate School of Public Health Office of Student Affairs. To apply to the Genetic Counseling Program, applicants use the SOPHAS Express system. The admissions process requires an interview. Further information is available on the Human Genetics web site; please see the Genetic Counseling Program section.

Admission to the Graduate Program in Genetic Counseling requires a bachelor's degree in a discipline related to the biological or behavioral sciences from an accredited college or university with a minimum quality point average (GPA) of 3.0. The General Graduate Record Examination (GRE) scores for the verbal, quantitative and analytical tests must be supplied with the application for admission and in general, should be above the 70th percentile in each of these three areas. Required undergraduate courses include: genetics, organic chemistry, general biochemistry, calculus, statistics, and a behavioral or social science. Prior to admission, student applicants are encouraged to volunteer at clinical genetic centers and/or at an agency that would offer opportunity to gain experience working with individuals in a crisis situation. Applicants also need to demonstrate a robust understanding of the genetic counseling profession.

Financial Aid

Tuition support is not normally available to students in the M.S. program, although M.S. students are typically able to arrange for hourly wage/stipend support from research mentors or other faculty. Students who have questions about the University's policy on sufficient academic progress for student loans should speak with the Assistant Dean for Student Affairs.

Overview

The Genetic Counseling Program in the Department of Human Genetics at the University of Pittsburgh has a long history. The Program was established in 1971 and is the second oldest program nationally. The Genetic Counseling Program received full accreditation from the American Board of Genetic Counseling in 1997, when accreditation was first offered, and has been fully accredited since that time.

Recent discoveries concerning the genetic contribution to human diseases mean that genetic counseling has an increasingly important role in health care delivery. The genetic counselor is trained to provide patients and families with pertinent genetic information to understand their risk for disease and to make informed decisions. The Genetic Counseling Program at the University of Pittsburgh is committed to providing up-to-date training in the complex science of human genetics, as well as in counseling skills. As a result, the Genetic Counseling Program is based on three important foundations: scientific training in human genetics, clinical experience, and understanding the psychology and social aspects of counseling.

The two-year program provides students with an in-depth background in human genetics/genomics and counseling. Training incorporates specific aspects of disease as they relate to individuals or families, including disease prognosis, consequences, treatment, risk of recurrence, and prevention. Observational rotations begin in the first year and participatory rotations take place in the second year and require students to integrate the science of human genetics with the social, psychological, moral, and ethical issues of genetic counseling. This program consists of prescribed courses during the first ten months, followed by an intensive rotation experience through the department's training programs at Children's Hospital of Pittsburgh, Magee-Women's Hospital, the Cancer Genetics Program, West Penn Hospital, Allegheny General Hospital, and the University of Pittsburgh Health System. All rotations sites are in the Pittsburgh area with a number of sites being located within walking distance from the Graduate School of Public Health.

The program provides coursework, clinical training and research experience to support the development of practice-based competencies in genetic counseling. A description of these competencies can be found at the Accreditation Council for Genetic Counseling web site: <http://gceducation.org/>. Most course work is completed in the first academic year. Observational clinical rotations occur in the first year and participatory clinical rotations begin in May and continue through March of the second year. Most students participate in approximately 200 cases during their clinical rotations.

The theory and application of counseling and interviewing including areas such as individual psychosocial development and dynamics; family dynamics; crisis intervention; psychosocial assessment and referral; grief/bereavement counseling; and cross cultural issues are incorporated throughout the curriculum. The social, ethical and legal issues as they pertain to the delivery of genetic services with review of health care delivery systems and principles of public health are provided in the Principles of Genetic Counseling course and the Intervention Skills for Genetic Counselors course.

The curriculum also includes principles and applications of human genetics and related sciences: cytogenetics; biochemical genetics; molecular genetics; population and quantitative genetics; human variation and disease susceptibility; embryology; and teratology.

Courses also address principles and practice of clinical/medical genetics: clinical features and natural history of a broad range of genetic diseases; indications for and methods of genetic diagnosis, including physical assessment, dysmorphology, laboratory and other diagnostic studies; indications for and methods of prenatal diagnosis including obstetric and genetic techniques; family history and pedigree analysis; risk assessment; use of the genetic literature; and case management skills.

The methods of genetic testing including indications, limitations, and methodology of tests used in cytogenetic, biochemical genetic, and molecular genetic laboratories are covered.

Teaching skills for presentations are reviewed in several classes and all students must present multiple cases at clinical case conference and at the rotation sites.

Research methods are reviewed in the biostatistics and epidemiology classes and are applied in the preparation of the Master's thesis project proposal.

Important: Please also read the ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS section on page 33.

Program Objectives

Students who receive the M.S. in genetic counseling will achieve the practice-based competencies outlined by the Accreditation Council for Genetic Counseling (ACGC). There are 22 competencies organized into four domains: (I) Genetic Expertise and Analysis, (II) Interpersonal, Psychosocial and Counseling Skills, (III) Education, and (IV) Professional Development and Practice. The practice-based competencies define the skill set and knowledge that an entry level genetic counselor must demonstrate to successfully practice within the profession. Below is the list of the competencies but to read more detailed information about the competencies please see the following ACGC document: <http://gceducation.org/>.

Domain I: Genetic Expertise and Analysis

1. Demonstrate and utilize a depth and breadth of understanding and knowledge of genetics and genomics core concepts and principles.

2. Integrate knowledge of psychosocial aspects of conditions with a genetic component to promote client well-being.
3. Construct relevant, targeted and comprehensive personal and family histories and pedigrees.
4. Identify, assess, facilitate, and integrate genetic testing options in genetic counseling practice.
5. Assess individuals' and their relatives' probability of conditions with a genetic component or carrier status based on their pedigree, test result(s), and other pertinent information.
6. Demonstrate the skills necessary to successfully manage a genetic counseling case.
7. Critically assess genetic/genomic, medical and social science literature and information.

Domain II: Interpersonal, Psychosocial, and Counseling Skills

8. Establish a mutually agreed upon genetic counseling agenda with the client.
9. Employ active listening and interviewing skills to identify, assess, and empathically respond to stated and emerging concerns.
10. Use a range of genetic counseling skills and models to facilitate informed decision-making and adaptation to genetic risks or conditions.
11. Promote client-centered, informed, non-coercive and value-based decision-making.
12. Understand how to adapt genetic counseling skills for varied service delivery models.
13. Apply genetic counseling skills in a culturally responsive and respectful manner to all clients.

Domain III: Education

14. Effectively educate clients about a wide range of genetics and genomics information based on their needs, their characteristics and the circumstances of the encounter.
15. Write concise and understandable clinical and scientific information for audiences of varying educational backgrounds.
16. Effectively give a presentation on genetics, genomics and genetic counseling issues.

Domain IV: Professional Development & Practice

17. Act in accordance with the ethical, legal and philosophical principles and values of the genetic counseling profession and the policies of one's institution or organization.
18. Demonstrate understanding of the research process.
19. Advocate for individuals, families, communities and the genetic counseling profession.

20. Demonstrate a self-reflective, evidenced-based and current approach to genetic counseling practice.
21. Understand the methods, roles and responsibilities of the process of clinical supervision of trainees.
22. Establish and maintain professional interdisciplinary relationships in both team and one-on-one settings, and recognize one's role in the larger healthcare system.

Coursework

A minimum total of 38 credits is required for the M.S. in Genetic Counseling. The following courses are required.

Fall Term of 1st year

BIOST 2041	Introduction to Statistical Methods 1	3 credits
EPIDEM 2110	Principles of Epidemiology	3 credits
HUGEN 2010	Bioinformatic Resources for Geneticists	1 credit
HUGEN 2022	Human Population Genetics	2 credits
HUGEN 2040	Molecular Basis of Human Inherited Disease	3 credits
HUGEN 2035	Principles of Genetic Counseling	3 credits
HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2047	Clinical Genetics Case Conference (must be taken four times)	0 credits
PUBHLT 2022	The Dean's Public Health Grand Rounds Embryology (online modules)	0 credits

Spring Term of 1st year

HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2031	Chromosomes and Human Disease	3 credits
HUGEN 2034	Biochem. and Mol. Genetics of Complex Disease	3 credits
HUGEN 2032	Genetic Techniques	2 credits
HUGEN 2038	Intervention Skills for Genetic Counselors	3 credits
HUGEN 2039	Risk Calculation in Genetic Counseling	1 credit
HUGEN 2052	Ethical Issues in Clinical and Public Health Genetics (take but do not register)	0 credits
HUGEN 2047	Clinical Genetics Case Conference (must be taken four times)	0 credits
PUBHLT 2011	Essentials of Public Health	3 credits
PUBHLT 2022	The Dean's Public Health Grand Rounds	0 credits
Observational Clinical Rotations		

Summer Term of 1st year

Begin participatory clinical rotations in the Summer Term (May 1)		
Professional Development and Advanced Research Summer Series		0 credits

Fall Term of 2nd year

HUGEN 2036	Genetic Counseling Internship	4 credits
HUGEN 2047	Clinical Genetics Case Conference (must be taken four times)	0 credits

Spring Term of 2nd year

HUGEN 2036	Genetic Counseling Internship	4 credits
HUGEN 2052	Ethical Issues in Clinical and Public Health Genetics (take but do not register)	0 credits
HUGEN 2047	Clinical Genetics Case Conference (must be taken four times)	0 credits

Comprehensive Examination

The Comprehensive Examination for M.S. Genetic Counseling students is a two-part examination. The written examination consists of 100 multiple choice questions in a format similar to the Certification Examination of the American Board of Genetic Counseling. The written examination is administered in the Fall term of the second year of study. A student failing a minimum score of 70% must repeat the written examination within 90 days and achieve a minimum score of 70% or undergo a series of supervised tutorial sessions to overcome areas of deficiencies. For the student who undergoes the tutorial sessions, he/she must retake the exam and achieve a minimum score of 70% after completion of the sessions. The second part of the examination, administered in the Spring term of the second year of study, consists of an oral examination based on a "fictional" clinical case presented to a panel of examiners. A student failing to achieve a passing score on the oral exam must satisfactorily complete a series of tutorial sessions under the direction of the Program Director or her designee.

Genetic Counseling Internship

The genetic counseling internship consists of rotations through the Division of Medical Genetics at Children's Hospital of Pittsburgh, the Division of Genetics and Genomics at Magee-Womens Hospital, the UPMC Cancer Genetics Program, the Cancer Genetics Program at Allegheny Health Network, the Reproductive Genetics Program at West Penn Hospital, and Genetics Services of the University of Pittsburgh Medical Center. There are a variety of subspecialties clinics that students participate in during their clinical training. In addition, each student has the opportunity to do an optional rotation in an area of interest.

Thesis Advisory Committee

The Thesis Advisory Committee should be selected by the student, in consultation with the research advisor.

Rules for M.S. Comprehensive Examination Committee membership:

- The committee must consist of at least three University of Pittsburgh faculty members.

- The committee chair can be a primary or adjunct faculty member in the Human Genetics Department or can be the student's research advisor, even if that individual does not have a primary appointment in Human Genetics.
- Half or more of the members must be on the core faculty list of at least one Pitt Public Health department. Adjunct professors are included on the core faculty list for the Department of Human Genetics; however, there is a limit of one adjunct faculty member per committee.
- One of the Pitt faculty on the committee must not be on the core list of the Human Genetics Department.

The committee must be approved by the Office of Student Affairs; this approval should be requested in a letter prepared by the Department of Human Genetics student services staff and signed by the student's program director or advisor. It is the responsibility of the Thesis Advisory Committee to guide the student in selecting an appropriate research topic and in the completion of a satisfactory thesis on an original problem in the area of the student's primary interest. The Committee will usually meet periodically with the student to give advice on the completion of the research project and preparation of the thesis. The Genetic Counseling Program has a Thesis Handbook that provides detailed information about the thesis requirement. This handbook is available in electronic format from the Program Director and Assistant Director.

M.S. Thesis

The M.S. thesis must demonstrate a mastery of knowledge in the specific topic area and demonstrate the student's ability to articulate a substantive research question and address the question through laboratory or non-laboratory research. The final thesis is written in a manuscript-style format to help facilitate the publication of students' research in a peer-reviewed journal.

To check for inadvertent plagiarism, the student must run the thesis through iThenticate, revise the thesis, if needed, in response to the results, and share the iThenticate report on the final version with the thesis advisor. An iThenticate account can be requested through the Office of Research (<http://www.research.pitt.edu/ithenticate>).

A final copy of the thesis must be submitted to the Thesis Advisory Committee for evaluation at least one week prior to the oral examination (thesis defense). The Thesis Advisory Committee will judge the adequacy of the thesis by an open oral examination covering the subject of the thesis. Successful completion of the M.S. thesis requires unanimous agreement by the Thesis Advisory Committee.

All M.S. students must register for at least one credit during the term in which they intend to graduate.

Students intending to graduate must file an application to graduate by the deadline specified in the University Calendar.

The final copy of the M.S. thesis must be prepared and submitted according to the University guidelines for Electronic Theses and Dissertations (ETD): <http://www.pitt.edu/~graduate/etd>. ***Please see the Thesis Handbook for additional details about the thesis.***

M.P.H. IN PUBLIC HEALTH GENETICS

Admission

Application for admission must be made through the Graduate School of Public Health Office of Student Affairs.

Candidates for the M.P.H. program in Human Genetics must meet the general admission requirements of the University of Pittsburgh Graduate School of Public Health M.P.H. program. In addition, the following departmental requirements and guidelines apply.

- Candidates must have a degree in a discipline relevant to public health or must have substantial knowledge of a discipline relevant to public health gained through either study or experience.
- Candidates should submit a personal statement describing their interests and educational goals.
- GRE scores must be submitted and should generally be above the 70th percentile in all categories.
- Coursework in genetics, biochemistry, and calculus is helpful but is not required.

Applicants who are graduates of an accredited college or university but who do not qualify for admission to full graduate status because of deficiencies in either their undergraduate course program or their scholastic achievement, may be considered for provisional graduate status if there is strong supporting evidence of their ability to successfully complete a graduate program. Courses taken to remove deficiencies do not count toward completion of graduate degree requirements. Transfer from provisional to full graduate status is initiated and recommended by the department, and is possible only after removal of deficiencies and other conditions noted at the time of admission and satisfactory progress in graduate course work.

Financial Aid

Tuition support is not normally available to students in the M.P.H. program, although M.P.H. students may be able to arrange for hourly wage/stipend support from research/practicum mentors. Students who have questions about the University's policy on sufficient academic progress for student loans should speak with the Assistant Dean for Student Affairs.

Overview

This M.P.H. program integrates genetics and the public health science disciplines of epidemiology, pathobiology, biostatistics, environmental health and health services research, with ethics, social sciences, public affairs, economics and law. Public health genetics focuses on phenotypic disease prevention in populations, not just individual patients and their families. It addresses society's legal, ethical, financial, regulatory and organizational responsibilities in offering genetic services, and devising environmental and occupational interventions to prevent disease in populations.

The requirements for the M.P.H. in Public Health Genetics can normally be fulfilled in two years of full-time study. General requirements are listed below, but the student should also review the requirements with his or her faculty advisor.

Important: Please also read the ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS section on page 33.

Program Objectives

A student completing the M.P.H. program in Public Health Genetics will be able to:

- Command and apply the essential competencies of public health's core content areas to complex public health issues.
- Demonstrate essential competencies of public health disciplines, especially use of genetic principles, in a public health practice setting.
- Apply and communicate knowledge of inheritance, including basic cellular and molecular mechanisms, and risk factors for disease to understanding a variety of rare and common health conditions.
- Identify interactions among genes, environmental factors, and behaviors and their effects on public health.
- Evaluate how genetic principles/technologies apply to diagnosis, screening, and interventions for disease prevention and health promotion programs, and how they intersect with other public health disciplines.

Coursework

A minimum of 47 credits is required for the M.P.H. This total is made up of school core courses, a core of required courses in the department of Human Genetics, and electives relevant to the student's program goals.

Required Human Genetics courses

HUGEN 2010	Bioinformatic Resources for Geneticists	1 credit
HUGEN 2011	Scientific Writing	1 credit
HUGEN 2022	Human Population Genetics	2 credits
HUGEN 2025	Human Genetics Seminar (must be taken two times)	0 credits
HUGEN 2034	Biochemical and Molecular Genetics of Complex Disease	3 credits
HUGEN 2040	Molecular Basis of Human Inherited Disease	3 credits
HUGEN 2049	Introduction to Public Health Genetics	3 credits
HUGEN 2050	Practicum	min 4 credits
HUGEN 2052	Ethical Issues in Clinical and Public Health Genetics	1 credit
HUGEN 2053	Applications of Public Health Genetics and Genomics	2 credits

School core course requirements

BIOST 2041	Principles of Statistical Reasoning	3 credits
BCHS 2509	Social and Behavior Sciences and Public Health	3 credits
EPIDEM 2110	Principles of Epidemiology	3 credits
EOH 2013	Environmental Health and Disease	3 credits
HPM 2001	Introduction to Leadership, Management, and Policy for Public Health	3 credits
*PUBHLT 2015	Public Health Biology	2 credits
PUBHLT 2016	Capstone: Problem Solving in Public Health	2 credits
PUBHLT 2022	The Dean's Public Health Grand Rounds (must be taken for the first two semesters)	0 credits

* Students in the Public Health Genetics program with adequate prior background may apply to be exempted from the requirement to take PUBHLT 2015. Most students do this.

Course Progression

There is a fair amount of flexibility in the scheduling of courses for the M.P.H., depending on the interests of the student and on any other degree or certificate programs in which he or she is enrolled. The most typical schedule for students starting during the Fall semester is as follows:

Fall Term of 1st year

BIOST 2011	Principles of Statistical Reasoning	3 credits
HUGEN 2010	Bioinformatic Resources	1 credit
HUGEN 2022	Human Population Genetics	2 credits
HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2040	Molecular Basis of Human Inherit Disease	3 credits
HUGEN 2049	Intro Public Health Genetics	3 credits
PUBHLT 2022	The Dean's Public Health Grand Rounds	0 credits
HUGEN 2050	Public Health Genetics Practicum	3 credits
Or HUGEN 2021	Special Studies or another course	
		15 credits

Spring Term of 1st year

HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2034	Biochem. Molecular Genet Complex Disease	3 credits
HUGEN 2052	Ethical Issues Clinical & Public Health Genetics	1 credit
HUGEN 2050	Public Health Genetics Practicum	2 credits
	Or HUGEN 2021 or another course	
BCHS 2509	Social & Behavioral Sciences & Pub Hlth	3 credits
EOH 2013	Environment Health and Disease	3 credits
HPM 2001	Intro to Leadership/Management/Policy	3 credits
PUBHLT 2022	The Dean's Public Health Grand Rounds	0 credits
		15 credits

Summer Term of 1st year

Practicum

Fall Term of 2nd year

EPIDEM 2110	Principles of Epidemiology	3 credits
HUGEN 2011	Scientific Writing	1 credit
HUGEN 2053	Applications in Public Health Genetics	2 credits
PUBHLT 2014	Public Health Biology (if not exempted)	2 credits
PUBHLT 2016	Applications in Public Health	2 credits
HUGEN 2021	or other course(s)	5 credits
		15 credits

Spring Term of 2nd year

HUGEN 2021	or other courses	2 credits
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TOTAL **47 credits**

The entire program can be completed in 1 1/2 years, if students register for 2 credits during Summer. However, most students prefer to spread the program out over two years.

Practicum and Masters Essay

All students are required to complete a Practicum. The Practicum is a supervised practice experience of at least 200 hours, providing students an opportunity to learn how genetics is applied in a public health setting and in the formulation and application of public health policy. It is highly recommended that M.P.H. students discuss potential practicum plans with the director of the M.P.H. program in Genetics by the spring of their first year.

Students must write a master's essay, which may be based on the practicum experience or on another topic related to public health genetics. All essays must include analysis of data. The essay topic must be approved by the Director of the M.P.H. in Public Health Genetics program. The essay is read and approved by an M.P.H. Essay Committee that must consist of at least one of the Public Health Genetics faculty members in Human Genetics and one from outside the department. The M.P.H. Essay Committee must be approved by the Office of Student Affairs. The essay must be approved by unanimous vote of the committee.

To check for inadvertent plagiarism, the student must run the essay through iThenticate, revise the essay, if needed, in response to the results, and share the iThenticate report on the final version with the MPH Essay Committee. An iThenticate account can be requested through the Office of Research (<http://www.research.pitt.edu/ithenticate>).

The final copy of the M.P.H. essay must be prepared and submitted according to the University guidelines for Electronic Theses and Dissertations (ETD): <http://www.pitt.edu/~graduate/etd>.

DUAL M.S. IN GENETIC COUNSELING AND M.P.H. IN PUBLIC HEALTH GENETICS

Overview

Students interested in receiving both the M.S. in genetic counseling and the M.P.H. in public health genetics may enroll in the dual degree program, which awards both degrees simultaneously at the end of the program. All requirements for both programs must be fulfilled, with the exceptions noted below. The dual degree program can often be completed in the time it takes to complete the MS in Genetic Counseling Program plus an additional summer, although there are a number of scheduling options available to students that can be customized based on student goals and preferences.

Important: Please also read the ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS section on page 33.

Admission

Application for admission to the dual degree program can be completed via several different pathways: 1) New applicants can choose to apply directly to the dual degree program via SOPHAS Express with the designation MPH Public Health Genetics/MS Genetic Counseling during the initial application process. Students will be admitted to each degree program separately. 2) Students accepted into the MS in Genetic Counseling Program can decide to pursue the dual degree program before or during the first semester with guaranteed admission. 3) Students accepted into the MPH in Public Health Genetics may apply to the MS in Genetic Counseling program during future admissions cycles. Students with questions about admissions to the Dual Degree Program can speak with the Director of the M.P.H. Public Health Genetics Program and/or Program Leadership for the Genetic Counseling Program.

Coursework

All required courses for both degrees must be taken by dual degree students, with the exception of PUBHLT 2011, Essentials of Public Health. The total number of credits required for the dual degree is 62. All programs are arranged individually with the Director of the M.P.H. in Genetics program.

M.S. Thesis and M.P.H. Essay

Usually, the student will submit both an M.S. thesis and an M.P.H. essay. The essay should focus upon elements of the practicum. The M.S. thesis and essay should be submitted electronically. If the M.S. thesis and M.P.H. essay topics are interrelated and involve substantial public health content, the student may submit these as a single document (in M.S. thesis form) to fulfill the requirements for both the thesis and the M.P.H. essay. This latter option needs prior approval from the director or co-director of the M.P.H. in Genetics program, and the director or co-director must sit on the combined thesis and essay committee. The M.S. thesis and essay must be submitted electronically. The final copy of the M.S. thesis and M.P.H. essay must be

prepared and submitted according to the University guidelines for Electronic Theses and Dissertations (ETD): <http://www.pitt.edu/~graduate/etd>.

OTHER DEGREE COMBINATIONS

Many students choose to combine a degree in Human Genetics with a degree in another department. In addition, some students pursue more than one degree within the department. Recent examples have included:

- M.P.H. and Ph.D. in Human Genetics
- M.P.H. in Epidemiology and Ph.D. in Human Genetics
- M.S. in Biostatistics and Ph.D. in Human Genetics
- M.S. in Human Genetics and Dr.P.H. in Epidemiology

Students considering pursuing more than one degree should talk to advisors in both departments as early as possible in the process. There are strict limits on the number of credits that may be "shared" between two degrees in different departments; in general a Masters and a Ph.D. may share only 24 credits, and two Masters degrees may share only 6, but consult the Assistant Dean for Student Affairs in the Pitt Public Health Office of Student Affairs for rules specific to your situation.

CERTIFICATE PROGRAM IN PUBLIC HEALTH GENETICS

Overview

The overall goal of the program is to give public health professionals the core genetics competencies that they need to integrate genetics into any public health discipline. Students enrolled in this certificate program are trained to incorporate knowledge of how genes, together with the environment and behavior, influence health and apply this insight into their area of practice or research. The certificate program assumes that participants already have standard public health competencies, or are in the process of acquiring them through other coursework.

Important: Please also read the ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS section on page 33.

Admission

The program is open to currently matriculated Pitt Public Health students and also to non-degree students who hold at least a bachelor's degree. The standards for admission are the same as those for the M.P.H. Applicants who are not enrolled in degree programs in Pitt Public Health must demonstrate prior public health experience in the form of academic work or appropriate job experience.

Program Objectives

Students completing the Public Health Genetics Certificate will be able to:

- Demonstrate basic knowledge of the role that genetics plays in the development of disease.
- Identify the limits of his/her genetic expertise.
- Identify ethical and medical limitations to genetic testing, including uses that don't benefit the individual.
- Identify the role of cultural, social, behavioral, environmental and genetic factors in the development and prevention of genetic-related diseases.

Curriculum

The curriculum consists of 15 credits, of which at least 12 must be traditional classroom courses. The remaining 3 credits can be seminar, project, or practicum work, as described below.

Required Course:

HUGEN 2049	3	Introduction to Public Health Genetics
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At least 6 credits from the following five courses are required to achieve competency in the basic science of genetics.

HUGEN 2010	1	Bioinformatic Resources for Geneticists
HUGEN 2022	2	Human Population Genetics
HUGEN 2031	3	Chromosomes and Human Disease
HUGEN 2034	3	Biochemical and Molecular Genetics of Complex Disease
HUGEN 2040	3	Molecular Basis of Human Inherited Disease

A maximum of 3 credits may come from the following courses.

HUGEN 2052	1	Ethical Issues in Clinical and Public Health Genetics
HUGEN 2050	1-3	Special Studies in Human Genetics – Practicum
HUGEN 2028	1	Human Genetics Journal Club and Peer Review
HUGEN 2047	1	Clinical Genetics Case Conference

Additional courses permitted for the certificate include the following.

All other Human Genetics courses

EPIDEM 2601	2	Molecular Epidemiology Laboratory
BCHS 2572	3	Risk Communication

Other courses may be permitted, but must be pre-approved by the Director of the MPH in Human Genetics Program in the Department of Human Genetics.

In addition, all students receiving the certificate must give a presentation in the Public Health Genetics course (HUGEN 2049).

Students enrolled in Human Genetics degree programs other than the M.P.H. in Public Health Genetics may receive the certificate, with the stipulation that the certificate curriculum must include at least 6 credits of coursework that is not part of the coursework for their degree and 3 credits of project or practicum work. The requirements for current Human Genetics students include:

- Six additional credits of coursework not already required by the student's degree program
 - Three of these credits must be HUGEN 2049: Introduction to Public Health Genetics
 - The additional three credits of coursework can come from the approved list of additional courses above or must be approved by the Director of Graduate Studies for the Department of Human Genetics.
- Three credits of a project or practicum work
 - A paper (10 double-spaced page minimum, plus references) describing the project or practicum is required to receive a grade for these credit hours. Writing guidelines will be provided to students.
- Students must give a presentation in HUGEN 2049 on a topic decided by the course instructor.

Advising

Each student who is admitted to the certificate program is assigned a faculty advisor who is responsible for helping the student choose courses and integrate the genetics experiences with the student's regular degree program or professional goals.

ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS

Institutional Review Board Approval

All research carried out by students in the Graduate School of Public Health which involves human subjects must be approved by the institutional Review Board of the University of Pittsburgh. It is the responsibility of the student, in consultation with their advisor, to assure that requirements for the protection of human subjects are met prior to initiating a research project. Information regarding IRB requirements and procedures is available at <http://www.irb.pitt.edu>. Students engaged in human subjects research must complete on-line training modules appropriate to their research area.

Research Integrity

All research and degree related activities in the Department of Human Genetics must comply with the policies of the University of Pittsburgh set forth in the Guidelines for Ethical Practices in Research. These guidelines are available from the Office of Research Integrity, University of Pittsburgh. All students must complete on-line training on research ethics and integrity modules.

Academic Integrity

Students are expected to be familiar with the University of Pittsburgh Policy on Academic Integrity, and are required to complete the Pitt Public Health on-line Student Academic Integrity Module. All new students enrolled in a Pitt Public Health program (certificate, degree, or non-degree) are required to complete this module during the first month of their first semester.

Bioinformatics Training

In addition to the formal courses offered through the Department, the Health Sciences Library offers a selection of excellent workshops and short courses on different topics and tools in bioinformatics. These are highly recommended for all Human Genetics students.

Grades

University policy dictates that in order to graduate the student have a cumulative grade point average (GPA) of at least 3.0 in all courses required for the degree. The Program requires that the student maintain a GPA of 3.0. Only A through F grades in required courses are employed for the GPA computation. A Pitt Public Health student whose cumulative GPA falls below 3.00 is immediately placed on academic probation, and the student, advisor, and department chairperson are notified by the Pitt Public Health Student Performance Committee. The student may be permitted to take additional coursework over no more than two terms (part-time students: a maximum of an additional 18 credit hours) to reach a GPA/GPA of 3.00. Students are given at most two opportunities to register for and pass each required course, including departmental requirements and Pitt Public Health core courses. In some cases a low grade in a non-required course can be omitted from the GPA for the purposes of the above calculations; in this case the course cannot count towards the number of credits required for graduation.

Research Credits

Students enrolled in the M.S. program register for HUGEN 2021 for their research credits, as do students enrolled in the Ph.D. program who have not yet started dissertation research. After starting dissertation research, students enrolled in the Ph.D. program can register for HUGEN 3010 unless/until they are registered for Full Time Dissertation Study.

Transfer Credit

Transfer credits and exemption from required courses should be discussed with the student's advisor as soon as possible after starting the program. In addition to consulting with the student's

advisor, students who are planning to transfer or share credits with other (current or previous) degrees should consult with Office of Student Affairs. No more than six credits may be granted toward the completion of the requirements for a master's degree for work completed at another accredited graduate institution. No more than 24 credits may be accepted for a master's degree awarded by another institution to meet the credit requirements for the Ph.D. degree. In recognition of graduate study beyond the master's degree successfully completed elsewhere, no more than 12 additional credits may be accepted at the time of admission to meet the minimum credit requirement. Exemption from Pitt Public Health core courses or departmental required courses is entirely separate from transfer credit, and requires permission of the course instructor.

Alternative schedules for completion of academic milestones

Schedules for completion of academic milestones (preliminary examination, comprehensive examination, etc.) are described above for typical full-time students. Part-time students and Ph.D. students who already have an M.S. when they enter the program should consult with their academic advisors and/or the Director of Graduate Studies to develop individualized time-lines.

Registration in terms prior to graduation

All graduate students must register for at least 1 credit or full-time dissertation study during the 12-month period preceding graduation (that is, must be on active status) and must be registered for the term in which they plan to graduate. Waivers may be obtained by submitting a written request to the registrar from the dean of the school. The request should be based on extenuating circumstances, e.g., inability of the student's Dissertation Committee to meet during the final term when a student has given reasonable notice or the student has completed all degree requirements in a previous term. Waivers will not be granted to students who are inactive.

Statute of Limitations

The purpose of a statute of limitations is to ensure that a graduate degree from the University of Pittsburgh represents mastery of current knowledge in the field of study. All requirements for the M.S. degree must be completed within a period of four consecutive calendar years from the student's initial registration for graduate study. All requirements for the Ph.D. degree must be completed within a period of ten years if the student has received credit for a master's degree appropriate to the field of study. Programs in which candidates pursue part-time study while working full-time within their chosen discipline, may be granted a longer statute of limitations at the discretion of the Dean, Graduate School of Public Health.

Under exceptional circumstances, a candidate for an advanced degree may apply for an extension of the statute of limitations. The request must be approved by the department or departmental committee (master's or doctoral) and submitted to the dean for final action. Requests for an extension of the statute of limitations must be accompanied by a departmental assessment of the work required of the student to complete the degree as well as documented evidence of the extenuating circumstances leading to the requested extension. Students who request an extension of the statute of limitations must demonstrate proper preparation for the completion of all current degree requirements.

Students are advised to review the school-wide Probation and Dismissal Policy and Procedures.

Student Organizations

Students of the Graduate School of Public Health have a Graduate Student Organization (GSO) with elected offices. The organization holds regular meetings to discuss academic matters as well as other items of interest to the students and the school. One elected member of the GSO sits on appropriate standing committees of the Graduate School of Public Health to represent the students at the committee meetings and provide a channel of communication between the entire faculty and the student body.

INFORMATION SPECIFIC TO MSTP (M.D. / PH.D.) STUDENTS

The University of Pittsburgh School of Medicine offers an M.D. / Ph.D. program that requires a minimum of six years of study. M.D. / Ph.D. students who choose to pursue Ph.D. training within the Department of Human Genetics will be eligible for graduate student tuition remission and stipend support while they are enrolled in the Ph.D. program. More complete information regarding details for the M.D. requirements and additional financial aid can be obtained from the Human Genetics Director of Graduate Studies or the Director of the M.D. / Ph.D. Program in the School of Medicine.

The medical student will be given credit equivalent to 16 graduate credits for completing the first two years of medical school.

INFORMATION SPECIFIC TO M.M.P.H. STUDENTS

The Department of Human Genetics welcomes students from the Multidisciplinary Master of Public Health (MMPH) program who wish to pursue coursework in genetics.

APPENDIX

RECOMMENDED TEMPLATE FOR THE DISSERTATION RESEARCH PROPOSAL

Overall recommendations¹

Your proposal should address the following questions:

- What do you intend to do?
- Why is this worth doing or what is the significance of the research? How is it innovative?
- What has already been done in general, and what have other researchers done in this field? Use appropriate references. What will this new work add to the field of knowledge?
- What have you (and your collaborators) done to establish the feasibility of what you are proposing to do?
- How will the research be accomplished? Who? What? When? Where? Why?

Purpose:

A dissertation proposal should be the basis for an open discussion of whether the student has a good project and how it can be improved. Potential and/or perceived flaws or uncertainties should be highlighted.

Suggestions:

1. Make sure that all sections are internally consistent and that they dovetail with each other. Use a numbering system, and make sections easy to find. Lead the committee members through your research plan. Revise and edit the final draft.
2. Show knowledge of recent literature and explain how the proposed research will further what is already known.
3. Emphasize how some combination of a novel hypothesis, important preliminary data, a new experimental system and/or a new experimental approach will enable important progress to be made.

Flexibility:

By providing this outline, we hope to lay out the usual questions that must be addressed in a comprehensive research proposal, as well as to provide a template for organizing the answers to those questions. However, while this is a recommended outline, it is not written in stone: the student, with the approval of their committee, may modify the outline to better fit the particulars of their research proposal.

Length:

There is no absolute limit on the length of the proposal, but it is recommended that the entire document be no more than 10 - 20 double-spaced pages of text and up to an additional 10 pages of references, appendices, tables, figures, etc. Already-written papers should be included as appendices, but should be summarized in the main body of the proposal. **A downloadable outline-only template in Word-format is available on the Human Genetics web site.**

¹ These recommendations are based on the following NIH documents with some modifications:
<http://deainfo.nci.nih.gov/extra/extdocs/gntapp.pdf>
<http://grants.nih.gov/grants/how-to-apply-application-guide/forms-d/research-forms-d.pdf>

Outline for a dissertation research proposal

[Title]

[Student name]

Human Genetics, Ph.D. Candidate
University of Pittsburgh
Graduate School of Public Health

[Date]

1. Hypotheses and Specific Aims

Purpose: The purpose of the specific aims is to describe concisely and realistically the goals of the proposed research and summarize the expected outcome(s), including the impact the proposed research will exert on the research fields involved.

What are the aims of your planned dissertation research?

Recommended Length: The recommended length of the specific aims is two double-spaced pages or less.

Content: The specific aims should:

- Describe the broad, long-term goals
- Describe the specific objectives and hypotheses to be tested
- Summarize expected outcomes
- Describe impact on the research field.

Suggestions:

1. Generally, the Specific Aims section should begin with a brief narrative describing the long-term goals or objectives of the research project and the hypothesis to be tested. This is followed by a numbered list of the Aims.
2. List succinctly the specific objectives of the research proposed, e.g., to test a stated hypothesis, create a novel design, solve a specific problem, challenge an existing paradigm or clinical practice, address a critical barrier to progress in the field, or develop new technology.
3. Make sure your specific objectives or hypotheses are clearly stated, are testable, and adequately supported by citations (and perhaps preliminary data). Be sure to explain how the results to be obtained will be used to test the hypothesis.
4. *Be brief and specific.* For clarity, each aim should consist of only one or two sentences. Use a brief paragraph under each aim if detail is needed.
5. Include a brief statement of the overall impact of the research studies.

2. Background and Significance

a. Background and Significance

b. Public Health Relevance

The Public Health Relevance section should be brief, no more than half a page.

Purpose: The Significance section should explain the importance of the problem or describe the critical barrier to progress in the field that is being addressed. Explain how the proposed research project will improve scientific knowledge, technical capability, and/or clinical practice in one or more broad fields. Describe how the concepts, methods, technologies, treatments, services, or preventative interventions that drive this field will be changed if the proposed aims are achieved.

What is already known about your research topics?

Why will the results of your research be important?

How will the results of your research contribute to public health?

Content: It should cover:

- the state of existing knowledge, including literature citations and highlights of relevant data
- rationale of the proposed research
- explain gaps that the project is intended to fill
- potential contribution of this research to the scientific field(s)
- include a sub-section addressing the *public health relevance* of your research

Suggestions

1. Make a compelling case for your proposed research project. Why is the topic important? Why are the specific research questions important? How are the researchers qualified to address these?
2. Establish significance through a careful review of published data in the field. Avoid outdated research. Use citations not only as support for specific statements but also to establish familiarity with all of the relevant publications and points of view.
3. Highlight awareness of potential barriers and alternative approaches.
4. Highlight why research findings are important beyond the confines of a specific project - i.e., how can the results be applied to further research in this field or related areas.
5. Clearly state the public health implications.
6. Stress any innovations in experimental methods (e.g., new strategies, research methods used, interventions proposed).

3. Preliminary Results

Purpose: The purpose of this section is to describe your progress towards the achievement of your aims.

What results have you already generated?

Content and Suggestions:

- Number the sections in this part of the application to correspond to the numbers of the Specific Aims; you may use further subheadings.
- Provide figures and tables to illustrate your key data
- Include sufficient methodological detail so that the committee members can understand how you obtained and analyzed the results
- Discuss difficulties, negative results and challenges in obtaining and analyzing your data
- Explain how the results support or refute your hypothesis and how your findings inform upcoming work
- Illustrate how your progress to date fits with your research timetable.

4. Approach

Purpose: The purpose of the approach section is to describe how the research will be carried out. This section is crucial to how favorably your proposal is viewed.

How will you accomplish your Specific Aims?

What methodology and approaches will you use and why?

Content: The research design and methods section should include the following:

- An overview of the experimental design.
- A description of methods and analyses to be used to accomplish the specific aims of the project.
- A discussion of potential difficulties and limitations and how these will be overcome or mitigated.
- Expected results, and alternative approaches that will be used if unexpected results are found.
- If the project is in the early stages of development, describe any strategy to establish feasibility, and address the management of any high risk aspects of the proposed work.
- A detailed discussion of the way in which the results will be collected, analyzed, and interpreted.
- A description of any new methodology used and why it represents an improvement over the existing ones.

Suggestions

1. Number the sections in this part of the application to correspond to the numbers of the Specific Aims.
2. Include subsections such as “Hypothesis”, “Rationale”, “Experiment 1”, “Experiment 2”, ..., etc, “Anticipated Results”, “Alternative Approaches”, etc.
3. Avoid excessive experimental detail by referring to publications that describe the methods to be employed. Publications cited should include some from your own research team, if possible. Citing someone else's publication establishes that you know what method to use, but citing your own (or that of a supervisor or collaborator) establishes that you are experienced with or have access to the necessary techniques.

4. If relevant, explain why one approach or method will be used in preference to others. This establishes that the alternatives were not simply overlooked. Give not only the "how" but the "why."
5. If employing a complex technology for the first time, take extra care to demonstrate familiarity with the experimental details and potential pitfalls. Describe collaboration with investigator(s) experienced with the technology, if necessary.
6. Explain how the research data will be collected, analyzed, and interpreted.
7. Develop alternative strategies for potential problems.
8. Point out any procedures, situations, or materials that may be hazardous to personnel and precautions to be exercised (i.e., use of Select Agents).

5. Anticipated Problems/Strategies

Purpose

A dissertation proposal should be the basis for an open discussion of whether the student has a good project and how it can be improved. Potential and/or perceived flaws or uncertainties should be **highlighted**.

What problems might you run into?

What alternative approaches might be used to achieve your goals?

Content and Suggestions:

- A discussion of potential difficulties, flaws, uncertainties, and limitations and how these might be overcome or mitigated.
- Alternative approaches that will be used if unexpected results are found.

6. Timeline

When and in what sequence will you accomplish your Aims?

Content and Suggestions:

- A projected sequence or timetable (work plan) including the entire time period of your dissertation research.

7. References

Purpose: The quality of reference section will indicate your familiarity with the relevant literature.

Content and Suggestions:

- Use of Endnote or other reference management software to make editing and formatting references easy and consistent.

8. Appendix

Content:

- Ethical and Safety Considerations section (see below for details).
- Your publications which include the results of your dissertation work.
- Large data tables or figures.

Ethical and Safety Considerations

Purpose: The purpose of this section is address any ethical issues associated with human subjects, animal subjects or hazardous materials research.

How will research risks be minimized?

Recommended length:

A few sentences per relevant subtopic.

Content and Suggestions:

- Discuss how human subjects are protected from research risks, and mention the IRB approval status of your work.
- Describe the procedures to ensure humane treatment of live animal subjects, mention the IACUC approval status of your work.
- Describe how the risks associated with the use of hazardous materials (recombinant DNA, infectious agent, chemical hazards, radioactive substances) are mitigated.