

STUDENT HANDBOOK
GUIDELINES FOR GRADUATE STUDY

Academic Year 2021–2022
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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:

- PhD in Human Genetics
- MS in Human Genetics
- MS in Genome Bioinformatics
- MS in Genetic Counseling
- MPH in Public Health Genetics
- Dual MS in Genetic Counseling and MPH in Public Health Genetics
- MD/PhD in Human Genetics (in collaboration with the MSTP program)
- Certificate (non-degree) program in Public Health Genetics

Detailed requirements for each program are described, in turn, below, followed by additional pertinent information for all degree programs. 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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(412) 624-3020 [fax]

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Graduate School of Public Health
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APPLICABILITY

Requirements described here formally apply only to students starting their degree program in the academic year corresponding to 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 requirements of the Student Handbook in effect when they first started their degree program. However, where required courses have been added, we strongly encourage our students to take these additional courses, if feasible.

DOCTOR OF PHILOSOPHY IN HUMAN GENETICS

Admission

Application for admission must be made through the Graduate School of Public Health Office of Student Affairs. Applications are considered twice per year, for Fall and Spring matriculation, although it is preferable for new students 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. Applicants with bachelor's degrees in other fields who have acquired foundational knowledge of genetics through coursework or work experience may also be considered for admission on a case by case basis. Prerequisites to admission to the program are courses in genetics and either calculus or statistics. Graduate Record Examination (GRE) scores must be supplied by all applicants, although there is no specific minimum GRE score required for admission. Subject GREs are not required. Students may apply directly to the PhD program regardless of whether they already have a master's degree. Students in good standing in a master's level degree program within the Department of Human Genetics may apply to the PhD degree program after completing at least two semesters. All applications are evaluated by the faculty based on academic performance, experience, personal statement, letters of recommendation, and scores on the GRE. For foreign students, the University of Pittsburgh requires an official score report from the TOEFL, IELTS, or Duolingo 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 minimum acceptable score on the Duolingo exam is 105. The TOEFL, IELTS, or Duolingo exam must be taken within two years prior to the application for admission.

A PhD 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 PhD degree. Individuals who are accepted to or have completed the University of Pittsburgh Genetic Counseling Program can apply to this focus within the PhD 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 of current graduate students

If you are a current MS or MPH student in the Graduate School of Public Health, and would like to apply to our PhD program please submit the following to the Office of Student Affairs:

- 1) An updated Statement of Purpose and Objectives, explaining your motivation and reasons for applying to the PhD program, experiences that prepared you for doctoral level research,

and career goals. Please let us know if you have already found a mentor with whom you will pursue your doctoral research.

- 2) 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. Daniel Weeks (weeks@pitt.edu) and Ms. 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 PhD 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 PhD program. After the first year, students are expected to arrange GSR appointments with their faculty mentors. Students who are admitted but not offered departmental aid may seek GSR positions directly with individual faculty. The department provides tuition support for all PhD students who hold GSR appointments. Continuation of a GSR position 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 Director of Student Services.

Overview

The PhD Program is comprised of a combination of coursework and original research, which usually allows attainment of the degree within 4–5 years. When the student enters the program, the student will be assigned an academic advisor who will follow the student's progress throughout the student's tenure in the program. In addition to the academic advisor, the student will engage in original research under the supervision of a research advisor who will foster the student's development as researcher and scientist. The University requires a minimum of six terms of full-time graduate study for the PhD degree. General requirements are listed below; the student should also consult with his/her academic advisor to plan a course of graduate study.

Important:

Please read **ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS**

Program Competencies

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.
- Apply a broad range of molecular, clinical, and analytical methodologies to design genetic studies.
- Use their conceptual and methodological knowledge to analyze data and interpret research results.
- Analyze and communicate published research in human genetics at the level needed for effective research and teaching.
- Apply fundamental principles of ethical research practice.
- Query bioinformatics resources to facilitate clinical decision-making or interpret research results.

Coursework

A minimum total of 72 credits is required. Students are required to obtain a grade of C or better for all 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	Bioinformatics 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 & Peer Review (must be taken twice; must present a paper at least once)	1 credit

Human Genetics core courses

HUGEN 2022	Human Population Genetics	2 credits
HUGEN 2029	Introduction to Gene Mapping	3 credits
HUGEN 2040	Molecular Basis of Human Inherited Disease	3 credits
HUGEN 2060	Chromosome Structure and Function	2 credits
HUGEN 2090	Genetics of Complex Disease 1	2 credits
HUGEN 2091	Genetics of Complex Disease 2	1 credit

Extra-departmental core courses

BIOST 2041	Introduction to Statistical Methods	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, students must complete at least one of the following departmental electives:

Human Genetics elective courses

HUGEN 2051	Inborn Errors of Development	2 credits
HUGEN 2071	Genomic Data Processing and Structure	3 credits
HUGEN 2072	Genomic Data Pipelines and Tools	3 credits
HUGEN 2073	Genomic Data Visualization and Integration	3 credits
HUGEN 2080	Statistical Genetics	3 credits

In situations where a student’s special interests or needs indicate an alternative course is more appropriate, it may be substituted for an elective course with the permission of the student’s academic advisor.

In addition to the courses listed above, students are expected to select, in consultation with their academic and research advisors, additional courses appropriate for their areas of concentration. In addition, a student’s Dissertation Committee may require that a student register for elective courses within or outside the Department of Human Genetics to gain knowledge in an area relevant to the student’s area of concentration. Furthermore, students who are not fluent in English are strongly recommended to take a University course in conversational English.

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

Summer Research in Progress Seminar

During the summer, the Department organizes a Summer Research in Progress Seminar series, where PhD students give talks describing their research. This event provides an opportunity to develop and practice scientific presentation skills, as well as receive helpful feedback in a supportive environment. PhD students are required to attend greater than 50% of the seminars each year for 3 years and present twice during their degree program.

Course Schedule for PhD 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 full-time PhD students across the first two years.

Fall Term First Year

BIOST 2041	Introduction to Statistical Methods	3 credits
EPIDEM 2110	Principles of Epidemiology	3 credits
PUBHLT 2022	The Dean’s Public Health Grand Round	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

Spring Term First Year

PUBHLT 2022	The Dean’s Public Health Grand Rounds	0 credits
HUGEN 2060	Chromosome Structure and Function	2 credits
HUGEN 2090	Genetics of Complex Diseases 1	2 credits
HUGEN 2091	Genetics of Complex Diseases 2	1 credit
HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2028	Human Genetics Journal Club and Peer Review	1 credit
PUBHLT 2011	Essentials of Public Health	3 credits
HUGEN 2021	Special Studies optionally another course	up to 6 credits variable

Summer Term First Year

Summer Research in Progress

Fall Term Second Year

PUBHLT 2030	Research Ethics	1 credit
HUGEN 2011	Scientific Writing in Human Genetics	1 credit
HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2029	Introduction to Gene Mapping	3 credits
HUGEN 2071	Genomic Data Processing and Structures and/or one or more other elective courses	3 credits
HUGEN 2021	Special Studies	up to 8 credits

Spring Term Second Year

HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2028	Human Genetics Journal Club and Peer Review	1 credit
HUGEN 2051	Inborn Errors of Development (offered in alternate years) and/or	2 credits
HUGEN 2080	Statistical Genetics (offered in alternate years) and/or	3 credits
HUGEN 2072	Genomic Data Pipelines and Tools and/or	3 credits
HUGEN 2073	Genomic Data Visualization and Integration and/or one or more other elective courses	3 credits
HUGEN 2021	Special Studies	up to 10 credits

Summer Term Second Year

Summer Research in Progress

Research Rotations and Choice of Research Advisor

During the first year of the PhD program, each student is expected to interview faculty members regarding possible research and dissertation areas. Most students participate in research rotations with 1 to 3 prospective research advisors during this time. By the end of the first year, the student should choose a research advisor who will assist in 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. Typically, the research advisor also provides GSR support for the student, although it is permissible for the student to be supported by a different faculty member than the dissertation research advisor. The student must submit to the Department written notification of the choice of a 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 who do not identify a permanent research advisor during their first year or who decide to switch research advisors after their first year may have their graduation timeline delayed. Students in these situations should continue interviewing faculty members and identify a permanent research advisor as soon as possible.

Students may select a 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. As the student progresses through the program, the research advisor takes primarily responsibility for the mentorship and professional development of the student, although the academic advisor continues to provide guidance to the student throughout his or her tenure in the program.

PhD 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 PhD program, preferably in the late Fall or Spring 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 Services Coordinate in the Department of Human Genetics, and she will check the graduate status of the committee members and arrange a room. The committee must be approved by the Office of Student Affairs; this approval will be requested in writing by the Department of Human Genetics student services staff.

Composition of the PhD Qualifying Examination Committee:

- 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. However, the Human Genetics Department recommends that three members of the committee should be core faculty members in the 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. The list of core educational faculty of the Human Genetics Department is available on the departmental website. Students should direct questions of the list of core educational faculty to Ms. Noel Harrie (nce1@pitt.edu).

The chair of the Qualifying Examination committee, 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 and must not have been presented previously at a Human Genetics Department event, such as a journal club or another student's Qualifying Examination. The paper should also fall far enough outside of the student's primary research area that the student has not already encountered the paper as part of his or her research. 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 human genetics knowledge related to the paper. 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.

A unanimous vote of the committee is required for a candidate to pass the Qualifying Examination. 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

The Comprehensive Examination is generally administered after the student has completed his/her coursework and has decided on a dissertation topic. Usually, the Comprehensive Exam is held one to two years after passing the Qualifying Exam and must be administered at least one semester after the Qualifying Exam was held and at least 8 months before the Dissertation Defense will be held. The student is responsible for initiating the appointment of a Comprehensive Examination

Committee and arranging a date for the examination. The student should inform Ms. Noel Harrie, the Student Services Coordinator, and she will check the graduate status of the committee members and arrange a room. The committee must be approved by the Office of Student Affairs; this approval will be requested in writing by the Department of Human Genetics student services staff. The function of this committee is to administer the examination. The Comprehensive Examination committee is typically chaired by the student's research advisor, and the committee members usually 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 composition of the PhD Comprehensive Examination Committee membership are identical to the rules for the composition of the PhD Dissertation Committee (see below).

For the Comprehensive Examination, the student is required to complete a written dissertation research proposal and present the proposal at an oral examination. Prior to scheduling the oral examination, the student should select an area of research in consultation with his or her research advisor and develop a set of draft Specific Aims describing the scientific objectives of the proposal. The student should discuss the draft Specific Aims of the research proposal with each member of the Comprehensive Examination Committee and revise the Aims as needed in response to feedback from the Committee members. When the draft Specific Aims are generally approved in principle by the Committee, the student should schedule the oral examination and prepare the written dissertation research proposal.

The written dissertation research proposal will provide the basis for an open discussion to determine whether the student has an appropriate project and how it can be improved. Potential and/or perceived flaws or uncertainties should be clearly highlighted and discussed. 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, the proposal is to be well-organized and 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 the entire document is recommended to be approximately 20 double-spaced pages of text (excluding references) and up to an additional 10 pages of supporting material such as appendices, tables, and figures. Already-written papers should be summarized in the main body of the proposal and may be included as appendices. The final written proposal must be delivered to all members of the committee a minimum of three weeks prior to the oral examination date unless all committee members agree to a later date.

At the oral examination, the student will give 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 foundational concepts underlying the contents. During the oral examination the student and Committee may discuss ideas for improving the proposed research project. If changes to the research plan are warranted, the Committee may require revisions to the written dissertation proposal and determine a timeline, typically a few weeks, for the student to submit the revised proposal. The student is graded pass/fail. A unanimous vote of the Committee decides the grade. A

passing grade is achieved when both of the following conditions are met: (i) the written proposal including any revisions is considered acceptable, and (ii) the student has performed knowledgeably in defense of the proposal. The chair of the Committee shall notify Ms. Noel Harrie, the Student Services Coordinator, of the decision and submit the completed, signed evaluation form. She will notify the department chair and obtain the chair's signature. She will then send the signed form to the Pitt Public Health Office of Student Affairs. In the event of a failure, the student will 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 will recommend either dismissal of the student from the program or that the student transfer to the MS degree program for the completion of his or her training. See the Pitt Public Health Probation and Dismissal Policy for more information.

PhD Dissertation Committee

The primary responsibility of the PhD Dissertation Committee is to advise the student regarding 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 PhD dissertation. The Dissertation Committee shall be proposed by the student in consultation with his or her research advisor and must be approved by the Office of Student Affairs.

Composition of the PhD Dissertation Committee:

- The committee must consist of at least four University of Pittsburgh faculty members, including the student's research advisor.
- At least two members must be on the list of core faculty 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 list of core faculty of the Human Genetics Department.

The Dissertation Committee should be convened immediately after successful completion of the Comprehensive Examination. Typically, the PhD Dissertation Committee comprises the same faculty members who served on the Comprehensive Examination Committee, in which case no additional action is required. If there will be any differences in membership of the Dissertation Committee compared to the Comprehensive Examination Committee, the student should inform Ms. Noel Harrie, the Student Services Coordinator. The Dissertation Committee must be approved by the Office of Student Affairs; this approval will be requested in writing by the Department of Human Genetics student services staff. Note that the Dissertation Committee chair is the student's research advisor and need not have a primary appointment in the Department of Human Genetics.

Annual Dissertation Committee Meetings

The student is responsible for organizing meetings of the Dissertation Committee *at least annually* to review the student's progress. One week prior to a scheduled meeting the student is to provide the Dissertation Committee with the student's most recent Spring Evaluation Form and a pre-

committee meeting report. After the meeting the student is responsible for circulating a post-committee meeting report to committee members for approval. If the committee deems the student has not made sufficient progress, a follow-up Dissertation Committee meeting must be scheduled within six months. A simple majority of the Dissertation Committee determines actions of the committee except for the final approval of the doctoral dissertation, which must be unanimous. Pre- and post-committee meeting forms are available on the departmental website.

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 may be either a traditional single narrative document, or a collection of individual self-contained works in the style of publishable (or published) papers. If the format is that of a compendium of papers, the dissertation must also include an introduction chapter with a comprehensive literature review and a substantial discussion chapter that tie together the body of work into a cohesive whole. If the papers have co-authors, the dissertation must also include a description of the student's contribution to each paper, including whether the student was the primary writer. The research advisor and one or more members of the Dissertation Committee may read preliminary drafts of the dissertation, suggest revisions, and approve the version submitted to the Dissertation Committee.

The student is responsible for scheduling the date and time of the Final Oral Examination (dissertation defense). The Final Oral Examination is usually taken one to four years after the Comprehensive Examination, when the dissertation research is completed. It should be taken at least 8 months after the Comprehensive Examination and per University policy it cannot take place in the same semester as the Comprehensive Examination. Students must notify the Department of Human Genetics 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.

To check for inadvertent plagiarism, the student must run the dissertation document through the anti-plagiarism software, iThenticate, revise the dissertation, if needed, in response to the results, and share the iThenticate report with the dissertation research advisor. An iThenticate account can be requested through the Office of Sponsored Projects.

The complete draft of the dissertation must be submitted to the Dissertation Committee at least three weeks prior to the Final Oral Examination unless all committee members agree to a later date. The defense must be scheduled at least three weeks prior to the dissertation submission deadline for the semester in which the student plans to graduate. The dissertation defense will consist of a public seminar on the dissertation topic followed by an examination by the Dissertation Committee. The Dissertation Committee may request modifications to the dissertation document. Approval of the dissertation is certified by a unanimous vote of the Dissertation Committee.

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.

Graduation

Students intending to graduate must file an application to graduate by the deadline specified in the University Calendar. All University of Pittsburgh students are required to register for at least one credit for the semester that they plan to graduate. The degree will be granted by the University of Pittsburgh.

Please read **ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS**

MASTER OF SCIENCE IN HUMAN GENETICS

Admission

Application for admission must be made through the Graduate School of Public Health Office of Student Affairs. Applications are considered twice per year, for Fall and Spring matriculation, although it is preferable for new full-time students to start the program in the Fall semester. 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. Applicants with bachelor's degrees in other fields who have acquired foundational knowledge of genetics through coursework or work experience may also be considered for admission on a case by case basis. Prerequisites to admission to the program are courses in genetics and either calculus or statistics. Graduate Record Examination (GRE) scores must be supplied by all applicants, although there is no specific minimum GRE score required for admission. Subject GREs are not required. Applications are evaluated by the faculty based on academic performance, experience, personal statement, letters of recommendation, and scores on the GRE. For foreign students, the University of Pittsburgh requires an official score report from the TOEFL, IELTS, or Duolingo 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 minimum acceptable score on the Duolingo exam is 105. The TOEFL, IELTS, or Duolingo exam must be taken within two years prior to the application for admission.

Financial Aid

Partial tuition support may be offered to students in the MS program. Students will be contacted about financial aid, if any, shortly after receiving notice of admission into the program. In addition, MS students may be able to arrange hourly wage positions from research advisors or through other student employment opportunities. Students who have questions about the University's policy on sufficient academic progress for student loans should speak with the Director of Student Services.

Overview

The MS in Human Genetics is a research-oriented degree, intended to prepare the graduate to participate in laboratory research or data analysis, or to go on to doctoral level study. The requirements for the MS in Human Genetics are often fulfilled in two years of full-time study. Students interested in pursuing a PhD are encouraged to apply directly to the PhD program; an MS is not required for entrance to the PhD program.

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

Program Competencies

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.
- Use their conceptual and methodological knowledge to analyze data and interpret research result.
- Apply fundamental principles of ethical research practice.
- Query bioinformatics resources to facilitate clinical decision-making or interpret research results.

Coursework

A minimum total of 36 credits is required for the MS in Human Genetics. Students are required to obtain a grade of C or better for all 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.

Human Genetics professional and scientific skills courses:

HUGEN 2010	Bioinformatics Resources for Geneticists	1 credit
HUGEN 2011	Scientific Writing for Human Genetics	1 credit
HUGEN 2025	Human Genetics Seminar (must be taken twice)	0 credits
HUGEN 2028	Human Genetics Journal Club & Peer Review (must present a paper at least once)	1 credit

Human Genetics core courses

HUGEN 2022	Human Population Genetics	2 credits
HUGEN 2040	Molecular Basis of Human Inherited Disease	3 credits
HUGEN 2060	Chromosome Structure and Function	2 credits
HUGEN 2090	Genetics of Complex Disease 1	2 credits
HUGEN 2091	Genetics of Complex Disease 2	1 credit

Extra-departmental core courses

BIOST 2041	Introduction to Statistical Methods	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	2 credits
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In addition to the required courses listed above, students must complete at least 11 credits through elective courses within or outside the Department of Human Genetics, HUGEN 2021 Special Studies research credits, or transfer credits from previous graduate level coursework. Elective courses and transfer credits counting toward the degree must be discussed and approved by the student’s academic and research advisors. Students who are not fluent in English are strongly recommended to take a University course in conversational English.

Course Schedule for MS 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 MS students.

Fall Term First Year

BIOST 2041	Introduction to Statistical Methods	3 credits
EPIDEM 2110	Principles of Epidemiology	3 credits
PUBHLT 2022	The Dean’s Public Health Grand Round	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

Spring Term First Year

PUBHLT 2022	The Dean’s Public Health Grand Rounds	0 credits
HUGEN 2060	Chromosome Structure and Function	2 credits
HUGEN 2090	Genetics of Complex Diseases 1	2 credits
HUGEN 2091	Genetics of Complex Diseases 2	1 credit
HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2028	Human Genetics Journal Club and Peer Review	1 credit
PUBHLT 2011	Essentials of Public Health	3 credits
HUGEN 2021	Special Studies optionally one or more other courses	up to 6 credits variable

Fall Term Second Year

PUBHLT 2030	Research Ethics	1 credit
HUGEN 2011	Scientific Writing in Human Genetics	1 credit
HUGEN 2021	Special Studies optionally one or more other courses	up to 13 credits variable

Spring Term Second Year

HUGEN 2021	Special Studies optionally one or more other courses	1 to 15 credits variable
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The number of HUGEN 2021 Special Studies credits taken in a student’s second 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.

Research Rotations and Choice of Research Advisor

During the first year of the MS program, students are expected to interview faculty members regarding possible thesis research projects. Some students elect to participate in research rotations with 1 to 3 prospective research advisors during this time, whereas other students progress directly into thesis research with a permanent research advisor. By the end of the first year, the student should choose a research advisor who will supervise the student’s thesis project. The student must submit to the Department written notification of the choice of a research advisor. Students who do not identify a permanent research advisor by the end of their first year or who decide to switch research advisors after their first year may have their graduation timeline delayed. Students in these situations should continue interviewing faculty members and identify a permanent research advisor as soon as possible. Students may select a research advisor from among the entire faculty of the University of Pittsburgh, provided the research project involves genetics in some way.

Comprehensive Examination

All MS students must pass a comprehensive examination covering areas of basic knowledge relevant to human genetics. The MS Comprehensive Examination follows the same form as the PhD Qualifying Examination (described above). The MS Comprehensive Examination must be taken in the fall or early in the spring of the second year for full-time students, if the student plans to graduate at the end of their second spring semester. The Comprehensive Examination 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 to serve on his or her Comprehensive Examination Committee and identified a date for the exam, the student will inform Ms. Noel Harrie, the Student Services Coordinator 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 writing by the Department of Human Genetics student services staff.

Rules for MS Comprehensive Examination Committee membership:

- The committee must consist of at least three University of Pittsburgh faculty members.
- The committee chair 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. 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 MS student plans to apply to transfer into the PhD program, then the Human Genetics Department strongly recommends that the Comprehensive Examination and MS Thesis Committees be chosen so they satisfy equivalent PhD committee composition requirements. In this case, both the MS Comprehensive examination and the PhD Qualifying examination will be taken on the same day.

MS 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 MS comprehensive examination, with the addition that the student's research advisor must be on the committee, and the thesis 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 comprising original scientific research. The Committee will meet periodically with the student to give advice on the completion of the research project and preparation of the thesis.

MS Thesis

The thesis must provide evidence of original scholarly research of sufficient quality to potentially contribute to a publication in a peer-reviewed scientific journal, but the scope of the MS thesis project does not need to comprise an entire self-contained publishable paper. The work performed as part of a thesis will represent one or more experiments or analyses.

The MS thesis must also demonstrate the student's ability to articulate a substantive research question and address the question through laboratory or non-laboratory research or, with permission of the Director of Graduate Studies in Human Genetics, 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 document through the anti-plagiarism software, iThenticate, revise the thesis, if needed, in response to the results, and share the iThenticate report with the thesis research advisor. An iThenticate account can be requested through the Office of Sponsored Projects.

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 MS thesis requires unanimous agreement by the Thesis Advisory Committee.

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

Graduation

Students intending to graduate must file an application to graduate by the deadline specified in the University Calendar. All University of Pittsburgh students are required to register for at least one credit for the semester that they plan to graduate. The degree will be granted by the University of Pittsburgh.

Please read **ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS**

MASTER OF SCIENCE IN GENOME BIOINFORMATICS

Admission

Application for admission must be made through the Graduate School of Public Health Office of Student Affairs. Applications are considered once per year for Fall matriculation. For specific application deadlines in any particular year, refer to the Pitt Public Health Office of Students Affairs information.

Admission requires a bachelor's degree in mathematics, computer science, biology, biotechnology, or related field from an accredited college or university, with a recommended grade point average of 3.0. Applicants with bachelor's degrees in other fields who have acquired substantial knowledge of quantitative or biological sciences through coursework or work experience may also be considered for admission on a case-by-case basis. Prerequisites to admission to the program are at least one course in calculus or statistics, one course in programming or coding, and one course in biology or genetics or a related field. Graduate Record Examination (GRE) scores must be supplied by all applicants, although there is no specific minimum GRE score required for admission. Subject GREs are not required. All applications are evaluated by the faculty based on academic performance, experience, personal statement, letters of recommendation, and scores on the GRE. For foreign applicants, the University of Pittsburgh requires an official score report from the TOEFL, IELTS, or Duolingo exam. The minimum acceptable TOEFL score is either 550 on the written test or 80 on the Internet-based 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 minimum acceptable score on the Duolingo exam is 105. The TOEFL, IELTS, or Duolingo exam must be taken within two years prior to the application for admission.

Financial Aid

Partial tuition support may be offered to students in the MS in Genome Bioinformatics program. Students will be contacted about financial aid, if any, shortly after receiving notice of admission into the program. In addition, MS in Genome Bioinformatics students may be able to arrange hourly wage positions from research advisors or through other student employment opportunities. Students who have questions about the University's policy on sufficient academic progress for student loans should speak with the Director of Student Services.

Overview

The MS in Genome Bioinformatics program provides didactic and hands-on training in manipulating, annotating, and interpreting human genomic data. The degree program integrates fields of data science, computer programming, statistics, and genetics, with a strong emphasis on the analysis of the human genome. The requirements of the MS in Genome Bioinformatics program are intended to be fulfilled in two years (four semesters) of full-time study, with a summer internship taking place after the first year.

Program objectives

After successful completion of the MS in Genome Bioinformatics program, students will be able to:

- Describe the methods for generating genomic data
- Describe data structures for holding genetic and genomic data
- Process genetic and genomic data
- Construct pipelines for high-throughput analysis of data
- Analyze genetic and genomic data to address research questions
- Annotate analysis results using contemporary bioinformatic resources
- Visualize quality metrics and analysis results
- Communicate analysis methods and results to stakeholders
- 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
- Describe the importance of ethical principles, diversity, and inclusion in genetics research

Coursework

A minimum of 45 credits is required for the MS in Genome Bioinformatics. Students are required to obtain a grade of C or better for all Bioinformatics, 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.

Bioinformatics core courses:

HUGEN 2071	Genomic Data Processing & Structures	3 credits
HUGEN 2072	Genomic Data Pipelines & Tools	3 credits
HUGEN 2073	Genomic Data Visualization & Integration	3 credits

Human Genetics core courses:

HUGEN 2022	Human Population Genetics	2 credits
HUGEN 2029	Introduction to Gene Mapping	3 credits
HUGEN 2040	Molecular Basis of Human Inherited Disease	3 credits
HUGEN 2090	Genetics of Complex Diseases I	2 credits
HUGEN 2091	Genetics of Complex Diseases II	1 credit

Extra-departmental core courses:

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

Human Genetics professional and scientific skills courses:

HUGEN 2010	Bioinformatics Resources	1 credits
HUGEN 2075	Genome Bioinformatics Internship & Capstone	6 credits
HUGEN 2079	Genome Bioinformatics Thesis	2 credits
HUGEN 2025	Human Genetics Seminar (must be taken two times)	0 credits

In addition to the required courses listed above, MS in Genome Bioinformatics students are expected to select at least 6 credits of elective courses and must complete an internship in an industry, academic, or governmental setting after the first year.

Course Schedule

The exact schedule of coursework may vary somewhat depending on students’ interests, skills, and knowledge. However, the following schedule is a typical sequence for most MS in Genome Bioinformatics students.

Fall Term of 1st year

BIOST 2041	Introduction to Statistical Methods	3 credits
HUGEN 2010	Bioinformatics Resources	1 credit
HUGEN 2022	Human Population Genetics	2 credits
HUGEN 2040	Molecular Basis of Human Inherited Disease	3 credits
HUGEN 2071	Genomic Data Processing & Structures	3 credits
PUBHLT 2030	Research Ethics	1 credits
HUGEN 2025	Human Genetics Seminar	0 credits

PUBHLT 2022	The Dean’s Public Health Grand Rounds [elective course]	0 credits <u>0–2 credits</u> 13–15 credits
<u>Spring Term of 1st year</u>		
HUGEN 2090	Genetics of Complex Diseases I	2 credits
HUGEN 2091	Genetics of Complex Diseases II	1 credit
HUGEN 2072	Genomic Data Pipelines & Tools	3 credits
HUGEN 2073	Genomic Data Visualization & Integration	3 credits
HUGEN 2025	Human Genetics Seminar	0 credits
PUBHLT 2022	The Dean’s Public Health Grand Rounds [elective courses]	0 credits <u>0–6 credits</u> 9–15 credits
<u>Summer of 1st year</u>		
Internship		
<u>Fall Term of 2nd year</u>		
HUGEN 2029	Introduction to Gene Mapping	3 credits
HUGEN 2075	Genome Bioinformatics Capstone	6 credits
EPIDEM 2011	Principles of Epidemiology [elective courses]	3 credits <u>0–3 credits</u> 12–15 credits
<u>Spring Term of 2nd year</u>		
HUGEN 2079	Genome Bioinformatics Thesis	2 credits
PUBHLT 2011	Essentials of Public Health [elective courses]	3 credits <u>0–10 credits</u> 5–15 credits

All University of Pittsburgh students are required to register for at least one credit in the semester that they plan to graduate.

Students are expected to select 6–21 credits of elective courses in their areas of interest, with approval and in consultation with the Program Director. The Program Director may require that a student register for specific courses within or outside the Department of Human Genetics to gain knowledge and/or skills in an area relevant to the student’s internship or thesis project. It is strongly encouraged that 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.

Summer Internship

As a requirement for completion of the program, MS in Genome Bioinformatics students must complete an internship in an industry, academic, or governmental setting. The internship experience will ideally produce the human genomic project that will form the basis of the MS thesis. After returning from the internship, students will work closely with faculty mentors and other

students to develop final analysis products based on their internship data to form an industry-appropriate data report.

Comprehensive Examination

Students in the MS in Genome Bioinformatics program take the Comprehensive Exam during the Fall of the second year, in the context of the *Genome Bioinformatics Capstone* course. The exam will evaluate the student's mastery of the material covered in the three Bioinformatics core courses as well as the foundational knowledge relevant to human genetics and public health covered in the other courses taken during the first year of study. The comprehensive exam consists of two parts: (1) an in-class written exam assessing the student's knowledge, and (2) an online take-home exercise assessing the student's coding and analysis skills. The exam will be designed, overseen, and scored by a Comprehensive Examination Committee, which will include the Program Director and/or instructors of the Bioinformatics core courses and other Human Genetics and/or University faculty. The exam will be scored as pass or fail, and the score will be reported to the Department Chair, who will forward it to the Office of Student Affairs. Students who do not meet the minimum criteria to pass will have the opportunity to retake the comprehensive examination one time, which will take place 4–8 weeks after the initial attempt. See the Pitt Public Health Policy on Probation and Dismissal.

The Comprehensive Examination Committee will be approved by the Office of Student Affairs and will consist of at least three University of Pittsburgh faculty members, with at least one member on and one member not on the core faculty list of the Human Genetics Department, with half or more members on the core faculty list of a Pitt Public Health Department, and with half or more members having graduate faculty status.

MS Thesis

MS in Genome Bioinformatics students will prepare an industry-appropriate report on the dataset derived from their summer internships. For circumstances in which the internship experience did not yield a sufficient project, students will have the opportunity to work with a University investigator's data instead. The thesis must provide evidence of data analysis and interpretation of sufficient quality to meet the expectations of an industry consultant. The style and format of the dissertation must conform to the standards set forth the University's Electronic Thesis and Dissertation (ETD) rules. The student must run a final draft of the thesis through iThenticate anti-plagiarism software and share the iThenticate report with the Program Director. An iThenticate account can be requested through the Office of Sponsored Programs.

A final copy of the thesis must be submitted to the Thesis Advisory Committee for evaluation. The Thesis Advisory Committee will be approved by the Office of Student Affairs and will meet the same requirements as the Comprehensive Examination Committee. Successful completion of the MS thesis requires unanimous approval of the Thesis Advisory Committee.

Graduation

Students intending to graduate must file an application to graduate by the deadline specified in the University Calendar. All University of Pittsburgh students are required to register for at least one credit for the semester that they plan to graduate. The degree will be granted by the University of Pittsburgh.

Please read **ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS**

MASTER OF SCIENCE IN GENETIC COUNSELING

(A PhD in Human Genetics with a focus on genetic counseling is available. Please see the PhD 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 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. Required undergraduate courses include genetics, organic chemistry, general biochemistry, statistics, and a behavioral or social science. In addition, please see the technical standards, which describe the abilities and characteristic necessary to successfully complete the requirements of the Program (https://www.publichealth.pitt.edu/Portals/0/HUGEN/gc_docs/Technical%20Standards_FINAL_no%20page%20numbers.pdf).

Prior to admission, student applicants are encouraged to gain exposure to the field of genetic counseling by volunteering at clinical genetic centers, speaking with practicing genetic counselors, and/or pursuing other opportunities to educate themselves about the field prior to admission. Many applicable experiences can shape an applicant's understanding of the field of genetic counseling. Such experiences may include podcasts, webinars, interviewing of genetic counselors, shadowing/observational experiences, conferences, selected journals and textbooks, relevant literature, etc.

For international student applicants, a minimum TOEFL score of 80 on the IBT or a minimum IELTS score of Band 6.5 or a minimum Duolingo exam score of 105 is required. Additional information on requirements is available here: <https://publichealth.pitt.edu/home/admissions-aid/how-to-apply/international-applicants>.

World Education Services (WES) Credential Evaluation of previous international degree program(s) are required, if applicable.

The Genetic Counseling Program participates in the genetic counseling admissions match through the National Matching Services (NMS). The match process has been established to enhance the process of placing applicants into positions in masters-level genetic counseling programs that are accredited by the Accreditation Council for Genetic Counseling (ACGC). All applicants must first register for the match with NMS before applying to participating genetic counseling graduate programs. Visit the NMS website (<https://natmatch.com/gcadmissions/>) to register for the match and to review detailed information about the matching process.

Financial Aid

Tuition support is not normally available to students in the MS in Genetic Counseling program, although MS in Genetic Counseling students are typically able to arrange for hourly wage support from research advisors or other faculty. Students who have questions about the University's policy on sufficient academic progress for student loans should speak with the Director of Student Services.

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 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/genomics, 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. 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/>. 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, 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 UPMC Children's Hospital of Pittsburgh, UPMC Magee-Women's Hospital,

the UPMC 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 several sites being located within walking distance from the Graduate School of Public Health. Most students participate in approximately 150–200 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.

Program Objectives

Students who receive the MS 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, order, facilitate, and integrate genetic/genomic testing 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 MS in Genetic Counseling. Students are required to obtain a grade of C or better for all 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.

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	0 credits
	(must be taken four times)	
PUBHLT 2022	The Dean’s Public Health Grand Rounds	0 credits
	Embryology (online modules)	

Spring Term of 1st year

HUGEN 2025	Human Genetics Seminar	0 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	0 credits
	Genetics (take but do not register)	
HUGEN 2047	Clinical Genetics Case Conference	0 credits

	(must be taken four times)	
HUGEN 2060	Chromosome Structure and Function	2 credits
HUGEN 2061	Cancer Genetic Counseling	1 credit
HUGEN 2090	Genetics of Complex Diseases I	2 credits
HUGEN 2091	Genetics of Complex Diseases II	1 credit
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 at the start of the Summer Term		
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	0 credits
(must be taken four times)		

Spring Term of 2nd year

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

Comprehensive and Oral Examinations

The MS Genetic Counseling students take two examinations during their second year of training. The comprehensive written examination consists of 100 multiple choice questions in a format similar to the Certification Examination of the American Board of Genetic Counseling. The comprehensive 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 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/his designee.

Genetic Counseling Internship

The genetic counseling internship consists of rotations through the Division of Medical Genetics at UPMC Children’s Hospital of Pittsburgh, the Division of Genetics and Genomics at UPMC Magee-Women’s Hospital, the UPMC Cancer Genetics Program, the Cancer Genetics Program at Allegheny Health Network, the Reproductive Genetics Program at West Penn Hospital, Genetics Services of the University of Pittsburgh Medical Center, and the Matilda Theiss Health Center, a

UPMC Family Medicine health 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 MS 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; the committee membership must be sent in an email by the student to the Department of Human Genetics student services staff and the staff will request approval 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 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 Guidebook that provides detailed information about the thesis requirement. This guidebook is available in electronic format from the Program Leadership.

MS Thesis

The MS 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 Sponsored Programs.

A final copy of the thesis must be submitted to the Thesis Advisory Committee for evaluation at least one week prior to the 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 MS thesis requires unanimous agreement by the Thesis Advisory Committee.

All MS 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 MS 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 Guidebook for further information about the thesis. It describes the objectives, process, thesis structure, requirements, and relevant resource information in greater detail.

Policies

The Genetic Counseling Program has a policy that describes support services and a policy that outlines professional impairment. For these and other policy and resource information, please see the following Department website: <http://www.publichealth.pitt.edu/human-genetics/academics/student-handbooks-forms>.

Important:

Please read ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS

MASTER OF PUBLIC HEALTH IN PUBLIC HEALTH GENETICS

Admission

Application for admission must be made through the Graduate School of Public Health Office of Student Affairs. Applications are considered twice per year, for Fall and Spring matriculation, although it is preferable for new full-time students to start the program in the Fall semester. For specific deadlines in any given year, refer to the Pitt Public Health Office of Student Affairs information.

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

- A bachelor's degree from an accredited college or university in a discipline relevant to public health, biology and/or genetics or a bachelor's degree in another field with substantial knowledge of a discipline relevant to public health gained either through study or experience.
- Six college credits in behavioral and/or social sciences (with a C or better).
- Three college credits in mathematics or statistics (with a C or better).

- An introductory course in genetics is required; other college level coursework in biology may be considered to fulfill this requirement on a case-by-case basis.
- A minimum TOEFL score of 80 on the IBT or a minimum IELTS score of Band 6.5 of a minimum Duolingo exam score of 105, if applicable. The TOEFL, IELTS, or Duolingo exam must be taken within two years of application.
- World Education Services (WES) Credential Evaluation of previous international degree program(s) if applicable.

Graduate Record Examination (GRE) scores are not required as part of the application for the MPH Program, although applicants do have the option of submitting GRE or other standardized test scores (i.e., MCAT) if they feel that they would strengthen their application.

Financial Aid

Partial tuition support may be offered to students in the MPH in Public Health Genetics program. Students will be contacted about financial aid, if any, shortly after receiving notice of admission into the program. In addition, MPH students may be able to arrange hourly wage positions from research advisors or through other student employment opportunities. Students who have questions about the University's policy on sufficient academic progress for student loans should speak with the Director of Student Services.

Overview

The Master of Public Health in Public Health Genetics Program integrates human 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 to prepare students for a career in the evolving field of public health genetics. Public health genetics integrates genetics with multiple public health disciplines to address society's legal, ethical, financial, regulatory, and organizational responsibilities in offering genetic services and developing interventions to bring genetic services to the public. A detailed program description can be found on the Pitt Public Health website.

The requirements for the MPH in Public Health Genetics are usually fulfilled in two years of full-time study. General requirements are listed below, but the student should also review the requirements with their faculty advisor.

Program Competencies

A student completing the MPH program in Public Health Genetics will be able to:

- Apply 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.
- Assess the ethics of the application of genetic technologies to public health.

- Communicate genetic and genomic principles to the general public as part of current public health initiatives.
- Evaluate how genetic principles/technologies apply to diagnosis, screening, and interventions for disease prevention and health promotion programs.

Coursework

A minimum of 47 credits is required for the MPH. This total is made up of school core courses, a core of required courses in the department of Human Genetics, and elective courses (from HUGEN or other departments) 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 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 2054	Applications in Public Health Genetics and Genomics	3 credits
HUGEN 2090	Genetics of Complex Diseases I	2 credits
HUGEN 2091	Genetics of Complex Diseases II	1 credit

School core course requirements

BIOST 2041	Introduction to Statistical Methods	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	2 credits
HPM 2001	Introduction to Leadership, Management, and Policy for Public Health	3 credits
PUBHLT 2015**	Public Health Biology	2 credits
PUBHLT 2022	The Dean’s Public Health Grand Rounds (must be taken for the first two semesters)	0 credits
PUBHLT 2033	Foundations in Public Health	1 credit
PUBHLT 2034	Public Health Communications	2 credits
PUBHLT 2035	Applications in Public Health	2 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 MPH, depending on student interest and on any other degree or certificate programs in which they are enrolled. The most typical schedule for students starting during the Fall semester is as follows:

Fall Term of 1st year

BIOST 2041	Introduction to Statistical Methods	3 credits
HUGEN 2010	Bioinformatics Resources for Geneticists	1 credit
HUGEN 2022	Human Population Genetics	2 credits
HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2040	Molecular Basis of Human Inherited Disease	3 credits
HUGEN 2049	Intro to Public Health Genetics	3 credits
PUBHLT 2022	The Dean’s Public Health Grand Rounds	0 credits
PUBHLT 2033	Foundations in Public Health	1 credit
PUBHLT 2034	Public Health Communications	2 credits
		15 credits

Spring Term of 1st year

HUGEN 2025	Human Genetics Seminar	0 credits
HUGEN 2052	Ethical Issues Clinical & Public Health Genetics	1 credit
HUGEN 2050	Public Health Genetics Practicum or Communications or another course	3 credits
HUGEN 2090	Genetics of Complex Diseases I	2 credits
HUGEN 2091	Genetics of Complex Diseases II	1 credit
BCHS 2509	Social & Behavioral Sciences & Pub Hlth	3 credits
EOH 2013	Environment Health and Disease	2 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 2054	Applications in Public Health Genetics	3 credits
PUBHLT 2014	Public Health Biology (if not exempted)	2 credits
PUBHLT 2035	Applications in Public Health	2 credits
HUGEN 2050	Public Health Genetics Practicum or other elective courses	4 credits
		15 credits

Spring Term of 2nd year

HUGEN 2021

or other elective courses

2–15 credits

TOTAL

47 credits

The entire program theoretically may 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

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 in a public health setting. Practicums may include experiences across the spectrum of public health settings, including those that focus on public health genetics. Students can choose to fulfill the practicum requirements through one experience or a combination of multiple experiences.

The MPH Program maintains a list of practicum opportunities open to students. Students can choose from this list or develop their own practicum experience. Practicums do not have to be completed in the Pittsburgh area. All MPH students must discuss potential practicum plans with MPH Program Leadership by the spring of their first year.

Students must facilitate the completion of all required practicum paperwork. Required forms are available on the Pitt Public Health website (<https://publichealth.pitt.edu/home/academics/other-academic-resources/forms>). Students must work towards developing five MPH competencies during their practicum experience(s). Three competencies must be from the main list of MPH competencies and up to two competencies can be from the list of competencies specific to the MPH Public Health Genetics Program. These competencies can be found on the practicum forms and the MPH Public Health Genetics Program website. Students must produce two products (deliverables) during their practicum that demonstrate the work that was completed during the experience. If a student is pursuing multiple experiences to fulfill their practicum requirement, only a total of five competencies and two products need to be identified across all experiences.

All practicum paperwork, products, and a description of how the student worked towards each of the five identified competencies are required to be uploaded into e-portfolio and approved by MPH Public Health Genetics Program Leadership.

MPH Essay

Students must write a master's essay, which may be based on the practicum experience or on another topic related to public health genetics. Students are encouraged to include analysis of data in their essays, but a variety of essay projects can be considered. The essay topic must be approved by the Director of the MPH in Public Health Genetics program. The essay is read and approved by an MPH Essay Committee that must consist of at least one primary faculty member in the Department of Human Genetics and one faculty member from outside the Department. The MPH 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 Sponsored Programs.

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

Important:

Please read ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS.

DUAL MASTER OF SCIENCE IN GENETIC COUNSELING AND MASTER OF PUBLIC HEALTH IN PUBLIC HEALTH GENETICS

Overview

Students interested in receiving both the MS in genetic counseling and the MPH 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 several scheduling options available to students that can be customized based on student goals and preferences.

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 MPH 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, except for 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 MPH in Genetics program.

Practicum

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 in a public health setting. Students can choose to fulfill the practicum requirements through one experience or a combination of multiple experiences. Typically, students in the dual degree program can count their hourly student work position (if applicable) or their clinical rotations as the practicum experience. All dual degree students must discuss their practicum plans with MPH Program Leadership by the spring of their first year.

Students must facilitate the completion of all required practicum paperwork. Required forms are available on the Pitt Public Health website (<https://publichealth.pitt.edu/home/academics/other-academic-resources/forms>). Students must work towards developing five MPH competencies during their practicum experience(s). Three competencies must be from the main list of MPH competencies and up to two competencies can be from the list of competencies specific to the MPH Public Health Genetics Program. These competencies can be found on the practicum forms and the MPH Public Health Genetics Program website. Students must produce two products (deliverables) during their practicum that demonstrate the work that was completed during the experience. If a student is pursuing multiple experiences to fulfill their practicum requirement, only a total of five competencies and two products need to be identified across all experiences.

All practicum paperwork, products, and a description of how the student worked towards each of the five identified competencies are required to be uploaded into e-portfolio and approved by MPH Public Health Genetics Program Leadership.

MS Thesis and MPH Essay

Usually, the student will submit both an MS thesis and an MPH essay. The MS thesis and essay will be submitted electronically. If the MS thesis and MPH essay topics are interrelated and involve substantial public health content, the student may submit a single document to fulfill the requirements for both the thesis and the MPH essay by adding an additional, substantial chapter to the MS thesis document for the essay project. This option needs prior approval from MPH in Public Health Genetics Program Leadership. Students can also choose to submit separate documents for the MS thesis and MPH essay. The final copy of the MS thesis and MPH essay must be prepared and submitted according to the University guidelines for Electronic Theses and Dissertations (ETD): <http://www.pitt.edu/~graduate/etd>.

Important:

Please read ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS

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:

- MPH and PhD in Human Genetics
- MPH in Epidemiology and PhD in Human Genetics
- MS in Biostatistics and PhD in Human Genetics

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 Master's and a PhD may share only 24 credits, and two Master's degrees may share only 6, but consult the Director of Student Services 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 certificate program in public health genetics 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 read **ADDITIONAL INFORMATION FOR STUDENTS IN ALL PROGRAMS.**

Admission

The program is open to currently matriculated Pitt Public Health graduate students and to non-degree students who hold at least a bachelor's degree. 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 may be seminar, project, or practicum work, as described below.

Required Course:

HUGEN 2049 3 Introduction to Public Health Genetics

At least 6 credits from the following six 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 2040	3	Molecular Basis of Human Inherited Disease
HUGEN 2060	2	Chromosome Structure and Function
HUGEN 2090	2	Genetics of Complex Diseases I
HUGEN 2091	1	Genetics of Complex Diseases II

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

Additional courses permitted for the certificate include the following.

All other Human Genetics courses		
EPIDEM 2600	3	Introduction to Molecular Epidemiology
BCHS 2572	3	Risk Communication

Other courses may be permitted but must be pre-approved by the Director of the MPH in Public Health 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 or other as determined by the Director of the MPH in Public Health Genetics Program).

Students enrolled in Human Genetics degree programs other than the MPH 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 in the Department of Human Genetics.
- Three credits of a project or practicum work (HUGEN 2050 or HUGEN 2021)
 - 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, or another course as determined by the Director of the MPH in Public Health Genetics Program, 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 the University’s Human Research Protections Office. 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 Pitt Public Health's online 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.

Degree Program Expectations Reflecting Pitt Public Health Educational Policies

School-level educational policies are detailed in the Graduate School of Public Health Academic Handbook. Students of all degree programs offered through the Department of Human Genetics must also adhere to these policies. Some of the expectations of Human Genetics degree programs that reflect pertinent School policies are summarized below, however, please refer to the official Academic Handbook for the exact text and details of the School-level policies.

Grades

Pitt Public Health policy dictates that to graduate the student must 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. A Pitt Public Health student whose cumulative GPA falls below 3.0 is immediately placed on academic probation, and the student, academic advisor, and department chair are notified by the Pitt Public Health Student Educational Policies and Curriculum 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 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 MS program register for HUGEN 2021 for their research credits, as do students enrolled in the PhD program who have not yet started dissertation research. After starting dissertation research, students enrolled in the PhD 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 academic advisor as soon as possible after starting the program. In addition to consulting with the

student's academic 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 PhD 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 and Program Director.

Alternative schedules for completion of academic milestones

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

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 MS 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 PhD 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 at 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 MEDICAL SCIENTIST TRAINING PROGRAM (MD / PHD) STUDENTS

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

Overall recommendations

A dissertation proposal should be the basis for an open discussion of whether the student has an appropriate project and how it can be improved. Potential and/or perceived flaws or uncertainties should be highlighted. The proposal should address the following questions:

- What scientific question will your research address and how will it be investigated?
- What is the public health significance of the research?
- What research has already been done in this area, and what gap in knowledge will your research fill? That is, what will your work add to the current body of scientific literature?
- What has been done to establish the feasibility of the proposed research?

The proposal should have a clear organizational structure, such as that shown in the example template, below. Make sure that all sections are internally consistent and that they dovetail with each other. Use thesis statements, conclusions, and signpost language to guide the reader through your document. Include informative section headings and numbering to make sections easy to find and navigate. Show knowledge of recent literature and explain how the proposed research will further what is already known. Emphasize how some combination of novel hypotheses, important preliminary data, a new experimental system, and/or a new experimental or data analysis approach will enable important progress to be made. Revise and edit the final draft based on feedback from your research advisor and/or committee members.

The outline below describes five main sections of the proposal, (1) Hypotheses and Specific Aims, (2) Background and Significance, (3) Approach, (4) Anticipated Problems and Alternative Strategies, and (5) Timeline. For each section we describe the purpose, recommended length, and content, as well as some suggestions. By providing this outline, we hope to lay out the usual questions that must be addressed in a comprehensive research proposal and provide a template for organizing the answers to those questions. However, while this is the recommended organizational structure, this outline can be adapted as needed to better fit the particulars of a student's research proposal.

There is no absolute limit on the total length of the proposal, but it is recommended that the main document be approximately 20 double-spaced pages of text (excluding references) with up to 10 additional pages of supporting materials such as appendices, tables, and figures. Already-written papers should be included as appendices, and 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.

Outline for a dissertation research proposal

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: 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. 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. 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. 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. Include a brief statement of the overall impact of the research studies.

2. Background and Significance

Purpose: The Background and Significance section should explain the importance of the research question 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?

Recommended Length: The length of the Background and Significance section will vary based on the topic and scope of the project, and is typically 2-5 pages.

Content: The Background and Significance section should:

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

Suggestions: The Background and Significance sections should make a compelling case for your proposed research project. The narrative should explain why your research topic is important and why the specific research questions are important. The section should establish the significance of the proposed project through a carefully curated review and synthesis of the most pertinent published findings in the field. Avoid common errors such as providing an exhaustive timeline of discoveries or referencing outdated literature or overturned hypotheses. Use citations to support specific statements and establish familiarity with the relevant publications and points of view. Highlight awareness of potential barriers and alternative approaches. Highlight why results of the proposed research may be important beyond the confines of the specific project, such as how the results can be applied to further research in the field or related areas. Clearly state the public health implications of the work. Stress any innovations in experimental methods (e.g., new strategies, research methods used, interventions proposed).

3. Approach

Purpose: The purpose of the approach section is to describe how the research will be carried out and present preliminary results showing your progress toward the achievement of your Specific Aims.

How will you accomplish your Specific Aims?
What methodology and approaches will you use and why?
What results have you already generated?

Recommended Length: The Approach section is the largest section of the dissertation research proposal, typically 8 to 15 pages.

Content: The Approach section should include the following:

- An overview of the experimental design.
 - This subsection can include general methods, datasets, and resources used across multiple Specific Aims
- Separate section that correspond to the Specific Aims; for each Aim include:
 - A description of methods and analyses to be used to accomplish the aim
 - A discussion of potential difficulties and limitations and how these will be overcome or mitigated
 - Preliminary results, if applicable, providing figures and tables to illustrate key data and results; interpretation of the preliminary results explaining how the results support or refute the hypotheses and how the findings inform forthcoming work

- A discussion of the expected results and how they will be interpreted, and alternative approaches that will be used if unexpected results are found

Suggestions: The Approach section often comprises the majority of the proposal. For most dissertation projects the Approach section can be organized into subsections representing an overview of the project followed by individual subsections for each Specific Aim. Depending on the particular project and commonalities across the Aims, details for experimental methods, analytical approaches, resources, datasets, and technologies may be better described in either the overview section or the sections describing each Specific Aim. To the extent possible, use parallel structure across the Aims, including subsections such as “Hypothesis”, “Rationale”, “Experiment 1”, “Experiment 2”, ... “Statistical Analysis”, “Preliminary Results”, “Anticipated Results”, “Alternative Approaches”, etc., as appropriate. Avoid excessive experimental detail by referring to publications that describe the methods to be employed but be sure to include key experimental details that impact your Committee’s ability to evaluate the proposed research. If relevant, explain why one approach or method will be used in preference to others. This establishes that the alternatives were not simply overlooked. Be sure to not only describe the “how” but the “why.” 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 investigators experienced with the technology, if necessary. Explain how the research data will be collected, analyzed, and interpreted. Discuss alternative strategies for potential problems. Point out any procedures, situations, or materials that may be hazardous to personnel and precautions to be exercised (i.e., use of Select Agents).

4. Anticipated Problems and Alternative Strategies

Purpose: A dissertation proposal should be the basis for an open discussion of whether the student has an appropriate project and how it can be improved. Potential and/or perceived flaws or uncertainties should be highlighted. Alternative strategies should be discussed. These issues can be addressed either within subsections for each Specific Aim in the Approach section, or as a standalone section.

What problems might you run into?

What alternative approaches might be used to achieve your goals?

Recommended Length: The length of the Anticipated Problems and Alternative Strategies section or subsections will depend on the scope of the project and is typically one half to 2 pages.

Content and Suggestions: This section or subsections should include a discussion of potential difficulties, flaws, uncertainties, and limitations of the project and how these might be overcome or mitigated. Describe any alternative approaches that will be used if unexpected results are found.

5. Timeline

Purpose: The timeline describes your anticipated progress through the proposed research project.

When and in what sequence will you accomplish your Aims?

Recommended length: The timeline is typically one half of a page or less.

Content and Suggestions: A projected sequence or timetable (work plan) including the entire time period of your dissertation research.