

HUMAN GENETICS, DOCTOR OF PHILOSOPHY (PH.D.) WITH A CONCENTRATION IN QUANTITATIVE HUMAN GENETICS

Program goal

The program is designed to provide students with the skills required to advance to positions as researchers and trainers in a broad spectrum of positions in human and molecular genetics. The structure of the program provides a framework for the progressive development of a mastery of the current state of the subject matter in human and molecular genetics and an ability to synthesize this information and apply this foundation to the identification of key areas of investigation and experimentation in this discipline. The program relates the above framework to the development of the ability to design, implement and interpret experimental approaches which address the questions identified. In addition, the program will develop skills in the various means of communicating both the core of human and molecular genetics knowledge and the expression of experimental design, results and interpretation to a variety of potential audiences.

Student learning outcomes

Human genetics core outcomes

1. Oral communication skills: The candidate will demonstrate the achievement of an appropriate level of oral communication skills with respect to the content, organization, logical flow, presentation and appropriate use of language incorporating the use of visual aids, as measured by rubric.
2. Written communication skills: The candidate will demonstrate the achievement of an appropriate level of written communication skill with respect to grammar, syntax, spelling and use of vocabulary to effectively present information including the use of figures, tables and citations as measured by rubric.
3. Experimental design: The candidate will demonstrate the achievement of an appropriate level of competence in the ability to appraise, modify and/or create, and implement experimental protocols and to design and develop experiments as measured by rubric.
4. Problem-solving skills: The candidate will demonstrate an appropriate level of skill in the identification and selection of meaningful problems to be addressed in research in human and molecular genetics, including the ability to defend said identifications and to design and develop appropriate methods to solve said problems as measured by rubric.
5. Integrated knowledge of human and molecular genetics: The candidate will demonstrate an appropriate level of knowledge of the current elements of human and molecular genetics as related to disciplinary specialization and a more detailed understanding of the individual area of scholarship, including an appropriate familiarity with the research literature and the ability to evaluate and critique publications as measured by rubric.

Quantitative human genetics concentration-specific learning outcome

1. Application of quantitative genetic methods: The candidate will demonstrate the ability to understand methods currently used in statistical genetics to map genetic variation onto complex traits, including the practical application of these methods to existing genetic and phenotypic data, which requires the appropriate use of computational methods for data management, statistical model building and reporting.

VCU Graduate Bulletin, VCU Graduate School and general academic policies and regulations for all graduate students in all graduate programs

The VCU Graduate Bulletin website documents the official admission and academic rules and regulations that govern graduate education for all graduate programs at the university. These policies are established by the graduate faculty of the university through their elected representatives to the University Graduate Council.

It is the responsibility of all graduate students, both on- and off-campus, to be familiar with the VCU Graduate Bulletin as well as the Graduate School website (<http://www.graduate.vcu.edu/>) and academic regulations in individual school and department publications and on program websites. However, in all cases, the official policies and procedures of the University Graduate Council, as published on the VCU Graduate Bulletin and Graduate School websites, take precedence over individual program policies and guidelines.

Visit the academic regulations section for additional information on academic regulations for graduate students. (<http://bulletin.vcu.edu/academic-regs/>)

Degree candidacy requirements

A graduate student admitted to a program or concentration requiring a final research project, work of art, thesis or dissertation, must qualify for continuing master's or doctoral status according to the degree candidacy requirements of the student's graduate program. Admission to degree candidacy, if applicable, is a formal statement by the graduate student's faculty regarding the student's academic achievements and the student's readiness to proceed to the final research phase of the degree program.

Graduate students and program directors should refer to the following degree candidacy policy as published in the VCU Graduate Bulletin for complete information and instructions.

Visit the academic regulations section for additional information on degree candidacy requirements. (<http://bulletin.vcu.edu/academic-regs/grad/candidacy/>)

Graduation requirements

As graduate students approach the end of their academic programs and the final semester of matriculation, they must make formal application to graduate. No degrees will be conferred until the application to graduate has been finalized.

Graduate students and program directors should refer to the following graduation requirements as published in the Graduate Bulletin for a complete list of instructions and a graduation checklist.

Visit the [academic regulations section](http://bulletin.vcu.edu/academic-regs/grad/graduation-info/) for additional information on graduation requirements. (<http://bulletin.vcu.edu/academic-regs/grad/graduation-info/>)

Other information

School of Medicine graduate program policies

The School of Medicine provides policies applicable to all programs administratively housed in the school. Information on **doctoral programs** is available elsewhere in this chapter of the Graduate Bulletin.

Apply online today. (<https://www.vcu.edu/admissions/apply/graduate/>)

Admission requirements

Degree:	Semester(s) of entry:	Deadline dates:	Test requirements:
Ph.D.	Fall	Dec 1 of year before matriculation	TOEFL if international

Special requirements

- Applications for the program must be submitted to the Biomedical Sciences Doctoral Portal – School of Medicine – Ph.D. selected from the drop-down menu of programs on the VCU online application form.
- Applications to the BSDP should be completed (i.e. receipt of all forms, letters, transcripts, etc.) by Dec. 1 of the year before matriculation. Applications completed after this date will be reviewed only as remaining spaces permit.

In addition to the general admission requirements of the VCU Graduate School (<http://bulletin.vcu.edu/graduate/study/admission-graduate-study/admission-requirements/>), successful applicants will typically have the following credentials:

1. A baccalaureate degree or its equivalent at the time of enrollment, with an undergraduate GPA of 3.5
2. TOEFL scores of 600 (pBT), 250 (cBT) or 100 (iBT) for individuals for whom English is a second language; or 6.5 on the IELTS (To report GRE or TOEFL score, use VCU Code 5570.)
3. Personal statements, which should include: long-term career goals to assess reasons behind the candidate's application; how a Ph.D. in biomedical science helps achieve those goals; the factors motivating a career in research; research experience, including dates, places and duration
4. Three letters of recommendation that speak to the scientific competency and experience of the applicant
5. The equivalent of two semesters of general chemistry, two semesters of organic chemistry and two semesters of upper-level biology courses (e.g. cell biology, molecular biology, biochemistry, genetics, neuroscience, physiology, biophysics, etc.)

Degree requirements

In addition to the general VCU Graduate School graduation requirements (<http://bulletin.vcu.edu/academic-regs/grad/graduation-info/>), students must complete a minimum of 86 graduate credit hours. The program requires at least three years of study for students entering with a B.S. or B.A. degree and must be completed within eight years.

The training programs in human and molecular genetics are intended to set the tone for a career and lifelong learning in human and molecular genetics by developing the student's knowledge of the field and skills in writing, laboratory techniques, critical thinking, data interpretation, study design, literature research and review, and integration of data from multiple disciplines while fostering the student's development as an independent researcher, laboratory director or teacher. These programs also seek to provide students with a core foundation of knowledge that will equip them to carry out translational research and for later work leading to certification by the American Board of Medical Genetics.

Students working toward the Ph.D. degree in human genetics pass through two stages of graduate study. The first stage consists primarily of course work recommended by the department and the student's graduate committee; the second stage consists of original research leading to the doctoral dissertation. Ph.D. students are expected to complete the required course work within four semesters and one summer, and they are intended to set the tone of a lifelong research career. In order to be considered in good academic standing, a student must maintain a 3.0 grade point average. The focus then shifts to the student's development as an independent researcher with emphasis being placed upon the development and execution of an original research project leading to the doctoral dissertation.

After the second year of study, students will take the Ph.D. candidacy examination. This exam comprises two parts, a departmental comprehensive examination and a written NIH-style application with an oral examination administered by the student's graduate committee. Upon successfully completing the departmental comprehensive and the oral exam, the student is admitted to Ph.D. candidacy. At this point, students are expected to develop and conduct dissertation research projects and to write and defend their dissertations describing their dissertation research.

Curriculum requirements

Course	Title	Hours
Core courses		
HGEN 501	Introduction to Human Genetics	3
HGEN 502	Advanced Human Genetics	3
HGEN 510	Classic Papers in Human Genetics	1
HGEN 606	Introduction to Clinical Genetics	1
HGEN 610	Current Literature in Human Genetics ¹	7
HGEN 611	Data Science I	3
HGEN 690	Genetics Research Seminar ²	8
IBMS 600	Laboratory Safety	1
IBMS 621	Laboratory Rotation I	2
IBMS 622	Laboratory Rotation II	2
IBMS 623	Laboratory Rotation III	2
Additional courses		
HGEN 651	Statistics for Genetic Studies I	3
OVPR 601	Scientific Integrity	1
or OVPR 602	Responsible Scientific Conduct	
or OVPR 603	Responsible Conduct of Research	
Concentration courses		
ANAT 620	Scientific Writing and Grantsmanship	2
HGEN 603	Mathematical and Statistical Genetics	3
HGEN 652	Statistics for Genetic Studies II	3
HGEN 619	Quantitative Genetics	3

or HGEN 612	Data Science II	
Electives		
Select one course from among: PATH 670; courses at the 500-level or above in ANAT, BIOC, BIOL, BIOS, BNFO, HGEN, LFSC, MICR, NEUS, PHTX and PHIS (excluding laboratory courses); courses specifically for professional programs (e.g. HGEN 600); directed research; independent study; seminar; current topic courses; MICR 608 and MICR 609.		3
Dissertation research		
HGEN 697	Directed Research in Genetics ³	35
Total Hours		86

1

HGEN 610 should be taken every fall and spring semester beginning the spring term of the first year.

2

HGEN 690 should be taken every fall and spring semester.

3

HGEN 697 should be taken every semester following the first year of study.

The minimum number of graduate credit hours required for this degree is 86.

Students who complete the requirements for this concentration will receive a Doctor of Philosophy in Human Genetics.

Typical plan of study

Many students often end up taking more than the minimum number of hours required for a degree program. The total number of hours may vary depending upon the program, nature of research being conducted by a study or in the enrollment or funding status of the student. The program requires at least three years of study for students entering with a B.S. or B.A. degree and must be completed within eight years. Students complete this degree program on average within five years. Students should refer to their program websites (<https://gen.vcu.edu/graduate-and-training-programs/phd-in-human-genetics/curriculum/>) and talk with their graduate program directors or advisers for information about typical plans of study and registration requirements.

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Program website: gen.vcu.edu (<https://gen.vcu.edu/>)