



Human Medical Genetics and Genomics Program

SCHOOL OF MEDICINE

UNIVERSITY OF COLORADO
ANSCHUTZ MEDICAL CAMPUS

Student Handbook

Updated July 2024

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GRADUATE PROGRAM DIRECTORS' WELCOME

The Human Medical Genetics and Genomics Graduate Program at CU is an interdisciplinary, interdepartmental program designed to coordinate outstanding graduate training and research opportunities in all aspects of Human and Medical Genetics. We and the HMGGP faculty are committed to nurturing and sustaining a dynamic and outstanding program that provides training and mentorship to the next generation of leaders in the fields of human and medical genetics and genomics.

These fields have expanded way beyond the horizon that was visible at the culmination of the Human Genome Project at the turn of this century. Rapid advances in high-throughput and low-cost technologies have enabled the discovery of thousands of genetic variants and genes critical to development, physiology, and diseases both common and rare. The vastness and complexity of the data generated by these technologies have instigated major strides in statistical and computational methods and tools for analyzing these data to generate hypotheses and gain insights. At the same time, advances in experimental systems and tools have enabled direct interrogation of genetic mechanisms of disease pathophysiology. We are in an exciting time where these experimental and computational advances are now leading to effective tests for rapidly identifying genetically susceptible individuals and new technologies for personalized treatment or even prevention of these diseases, contributing to overall improvement of health and quality of life for everyone. It is the mission of the Human Medical Genetics and Genomics Graduate Program to be at the forefront of this revolution.

The Human Medical Genetics and Genomics Graduate Program is built on close engagement with our students, who are integral to our ongoing mission to build towards the future. The Program is continually adding new Training Faculty, providing students with an outstanding group of scientists from whom to select as Thesis Advisors and Mentors. Our goal is to provide students with a world-class graduate training experience in an interactive and collaborative environment that allows for an individualized learning experience.

Sincerely,
Arjun Krishnan & Kelly Sullivan

HMGGP ACADEMIC REQUIREMENTS CHECKLIST

FIRST-YEAR STUDENTS

FALL SEMESTER

- BMSC 7806 Core I, Foundations in Biomedical Sciences (6 credits)
- BMSC 7810, Core Topics in Biomedical Science (2 credits per section) (required to take one course from each date session, there are two sets of session dates)
- HMGP 7610-001, Topics in Human Genetics (Seminar) (1 credit)
- HMGP 7650-001 and 7650-002 Research in Human Medical Genetics (one credit each section for 2 credits total)
- First rotation – Pre-rotation paper, due by the end of the first week of lab rotation
- First rotation - Post-rotation paper, due on the day after lab rotation seminar
- First rotation seminar
- Second rotation - Pre-rotation paper, due by the end of the first week of lab rotation
- Attend the Human Medical Genetics and Genomics Program Annual Retreat. This is a required Program function for all students.
- Start the process to attain Colorado Residency (if not a resident, go to Registrar link for steps to complete, <https://www.cuanschutz.edu/registrar/residency/current-students>)

SPRING SEMESTER

- HMGP 7600 Survey of Genetics (4 credits)
- HMGP 7610-001 (section 001 is for 1st year students only), Topics in Human Genetics (Seminar) (1 credit)
- HMGP 7650-001 Research in Human Medical Genetics (1 credit)
- Bioinformatics Course (Required) (see Appendix 2 for additional information and course options)
- Second rotation - Post-rotation paper, due on the day after lab rotation seminar
- Second rotation seminar
- Third rotation - Pre-rotation paper, due within 1 week of starting the rotation
- Third rotation - due on the day after lab rotation seminar
- Third rotation seminar
- Preliminary Examination (early June)
- Identify a mutually agreeable thesis laboratory

SUMMER SEMESTER

- BSBT 6060-004 Speaking and Presenting for Scientists and Educators (1 credit) (*recommended if no conflict with required courses or program activities like Thursday seminar and after seminar meetings*)
- Doctoral Thesis HMGP 8990, 1 credit (*required for insurance and tax purposes*)
- Petition for Colorado Residency if not a resident, (go to Registrar link for steps to complete, <https://www.cuanschutz.edu/registrar/residency/current-students>)
- Begin thesis lab work July 1, continues through graduation

**** HMGGP students second year and up need to be registered in a minimum of 5 credits in each of the fall and spring semesters (equivalent of being a full-time graduate student), and in 1 credit of HMGP 8990 in the summer.****

SECOND-YEAR STUDENTS

FALL SEMESTER

- HMGP 7610-002 (section 002 is for 2nd year students only) Topics in Human Genetics (Seminar) (1 credit)
- HMGP 7650-0V3 Research in Human Medical Genetics (at least 1 credit but can take up to 5 credits if needed to meet the 5 credits required for full-time status)
- BMSC 7811 RESPONSIBLE CONDUCT OF RESEARCH (1 credit)
- Biostatistics Course (Required) (see Appendix 1 for additional information and course options).
- Bioinformatics Course (if not completed in Year 1) (see Appendix 2 for additional information and course

options)

- Research in Progress (RIP) Seminar (one required presentation per academic year per student)
- Elective
- Form your Comprehensive Exam Committee (CEC) by November 1st
- Attend the Human Medical Genetics and Genomics Program Annual Retreat. This is a required Program function for all students. Students in their second year are required to present a poster at the retreat.

SPRING SEMESTER

- HMGP 7610-002 Topics in Human Genetics (Seminar) (1 credit)
- HMGP 7650-0V3 Research in Human Medical Genetics (at least 1 credit but can take up to 5 credits if needed to meet the 5 credits required for full-time status)
- Biostatistics Course (Optional) (only for students interested in advanced biostatistics electives)
- Elective (not required if completed last fall)
- Prepare for Comprehensive Examination
- Research in Progress Seminar (not required if completed in the fall)
- Petition for Admission to Ph.D. Candidacy (min. 4 weeks before comprehensive examination date)

SUMMER SEMESTER

- Thesis Laboratory HMGP 8990, 1 credit, or HMGP 7650-0V3, 3 credits. (*required for insurance and tax purposes*)
- Schedule Comprehensive Examination (must be taken during the fall semester, at the beginning of your 3rd year and before October 1st) ****Important:** 5 research hours required when taking Comprehensive Examination

THIRD-YEAR STUDENTS

FALL & SPRING SEMESTERS

- HMGP 7610-003 (section 003 is for 3rd year students only) Topics in Human Genetics (Seminar) (1 credit)
- HMGP 8990 Thesis Laboratory (at least 1 credit but can take up to 5 credits if needed to meet the 5 credits required for full-time status)
- Research in Progress Seminar (one required presentation per academic year)
- Form your Thesis Advisory Committee (TAC), no later than December 15th, following your Comprehensive Exam.
- Students must meet their TAC annually. The program recommends that students meet with their TAC once every six months. It is the student's responsibility to schedule these meetings and *inform the Program Administrator of your TAC meeting date.*
- Attend the Human Medical Genetics and Genomics Program Annual Retreat. This is a required Program function for all students. Students in their third year are required to present a poster or platform talk at the retreat.

SUMMER SEMESTER

- HMGP 8990 Thesis Laboratory (1 credit) (*required for insurance and tax purposes*)

FOURTH YEAR STUDENTS & BEYOND

FALL & SPRING SEMESTERS

HMGP 8990 Thesis Laboratory (5 credits) ****Important:** 5 research hours required when taking Thesis Defense

- Research in Progress Seminar (one required presentation per academic year)
- All fourth-year students are required to sign up for the group sessions of the Fall Ethics course (BMSC 7811) to be up to date according to the NIH guidelines. You do not need to officially register for the course, but you must email your Program Administrator to find out who is organizing the sign up for these group sessions.
- Students must meet their TAC annually. The program recommends that students meet with their TAC once every six months. It is the student's responsibility to schedule these meetings and inform the Program Administrator of your TAC meeting date.
- Attend the Human Medical Genetics and Genomics Annual Retreat during the Fall Semester. This is a required

Program function for all students. Students in their fourth year and beyond are required to present a poster or platform talk at the retreat.

SUMMER SEMESTER

- HMGP 8990 Thesis Laboratory (1 credit) (*required for insurance and tax purposes*) ****Important: 5 research hours required when taking Thesis Defense**

IMPORTANT DATES AND DEADLINES (Academic Year 2024-25)

FIRST-YEAR STUDENTS

- 1) First Rotation: August 26 – November 15, 2024
- 2) Pre-rotation paper for first rotation due on August 30, 2024, by 5 PM
- 3) Rotation Talk for first rotation: November 14, 2024
- 4) Post-rotation paper for first rotation due on November 15, 2024, by 5 PM
- 5) Second Rotation: November 18 – February 21, 2025
- 6) Pre-rotation paper for second rotation due on November 22, 2024, by 5 PM
- 7) Rotation Talk for second rotation: February 20, 2025
- 8) Post-rotation paper for second rotation due on February 21, 2025, by 5 PM
- 9) Third Rotation: February 24 – May 16, 2025
- 10) Pre-rotation paper for third rotation due on February 28, 2025, by 5 PM
- 11) Rotation Talk for third rotation: May 15, 2025
- 12) Post-rotation paper for third rotation due on May 16, 2025, by 5 PM
- 13) Preliminary Examination – oral examination is usually held in mid-June and is based on the schedule and availability of the members of the Committee. The actual date will be released on or around May 16, 2025.
- 14) Join Thesis Laboratory – anytime after May 15, 2025, but no later than July 1, 2025.

SECOND-YEAR STUDENTS

- 1) Submit and get approval of proposed Comprehensive Examination Committee by Program Directors by November 1, 2024
- 2) Introduction meeting (please see handbook for details) with Comprehensive Examination Committee by April 1, 2025
- 3) Application for Candidacy form and a Request for Scheduling Exam forms need to be completed at least **FOUR WEEKS** prior to the scheduled Comprehensive Examination
- 4) Comprehensive Examination has to be completed by October 1, 2025
- 5) Please refer to handbook under Comprehensive Examination Committee for details on format, expectations and deadlines for the Comprehensive Exam.

THIRD-YEAR STUDENTS

- 1) Submit and get approval of proposed Thesis Advisory Committee by Program Directors by December 15, 2024
- 2) Schedule 1st Thesis Advisory Committee Meeting by April 1, 2025
- 3) Please refer to handbook under Thesis Advisory Committee for details on format, expectations and deadlines for the TAC meetings

FOURTH-YEAR STUDENTS & BEYOND

- 1) Schedule annual Thesis Advisory Committee Meeting – has to be scheduled no later than ONE calendar year after previous TAC meeting. For example, if your past TAC meeting was on April 1, 2024, then the next one has to be completed by April 1, 2025.
- 2) Please refer to handbook under Thesis Advisory Committee for details on format, expectations and deadlines for the TAC meetings

DISSERTATION DEFENSE

- 1) The dissertation defense and graduation deadlines are available [here](#), along with instructions for submitting the written thesis using ProQuest.
- 2) Please refer to handbook under The Doctor of Philosophy Dissertation for details on format, expectations and deadlines for the dissertation defense

The **ACADEMIC CALENDAR** for **2024-25** is available [here](#).

IMPORTANT CONTACT INFORMATION

FACULTY

You can find our updated training faculty and non-training faculty on our [website](#).

HMGGP ADMINISTRATION

Arjun Krishnan, PhD

Associate Professor and Program Co-Director

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Vanessa Martinez, MBA

Office of Research Education, Program Administrator

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Admissions, Recruitment, and Student Affairs

(curriculum, exams, bi-annual Program required presentations, and any Office of Research Education related needs)

SOM | OFFICE OF RESEARCH EDUCATION - <https://medschool.cuanschutz.edu/ore>

Shanta M. Zimmer, MD

Senior Associate Dean for Education

303.724.8224

Angeles (Angie) B. Ribera, Ph.D.

Associate Dean of Research Education

303.724.4517

Andrew Bradford, Ph.D.

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PROGRAM MAILING ADDRESS

University of Colorado AMC

Human Medical Genetics and Genomics Program

Research One North, Mail Stop 8300

12800 E. 19th Ave.

Aurora, CO 80045

OTHER IMPORTANT NUMBERS

Emergency- Police or Fire	911 from Campus landline
Campus Emergency (<i>using cell phone</i>)	303-724-4444
Campus Police (<i>non-emergency/using land line</i>)	303-724-4444 from Campus
Emergency outside on Campus	Use Blue Light phones
Escort Service to Car	303-724-2000
Admissions and Records	303-724-8059
Bookstore	303-724-2665
Bursar's Office	303-724-8032
Counseling	303-556-4372
Dental Clinic	303-704-6900
Diversity Office	303-724-8003
E-mail Support	303-724-2129
Financial Aid	303-556-2886
Health Insurance	303-724-7674
ID Cards	303-724-0399
Library	303-724-2139
Ombudsman Office	303-724-2950
Parking Office	303-724-2555
Student Health Office	303-724-4674
Student Assistance Office	303-724-7686
CU Pharmacy	720-848-1020

IMPORTANT WEBSITES:

Office of Student Affairs	https://www.cuanschutz.edu/student
Student Health Insurance	https://www.cuanschutz.edu/student/health-wellness/student-health-insurance
Office of Research Education (ORE)	https://medschool.cuanschutz.edu/ore
Graduate School	https://graduateschool.cuanschutz.edu/
Registrar	https://www.cuanschutz.edu/registrar
Residency	https://www.cuanschutz.edu/registrar/residency
Student Resources	https://www.cuanschutz.edu/registrar/student-resources
2024-2025 Academic Calendars (see <i>Graduate School calendars</i>)	https://www.cuanschutz.edu/registrar/academic-calendars/2024-2025

CRITICAL INFORMATION

PRIORITIES FOR THE FIRST FEW WEEKS

Both the SOM Office of Research Education and the Human Medical Genetics and Genomics Ph.D. Training Programs schedule orientation sessions to help students through their first few days on campus. In addition, the Office of Research Education will require each new student to complete an online orientation session. During the first year, until students have selected a Thesis Advisor and formed a committee, the Graduate Advisory Committee (GAC) will serve as the student Advisors. New students will meet with the GAC periodically; this is a time to express any concerns or difficulties, to ask any questions that have arisen, and to discuss potential future rotation choices or the choice of thesis lab.

Program Transfer: For students matriculating directly into Basic Science Ph.D. Programs, there is an expectation that you will remain in that Program. You have matriculated into that Program by virtue of having applied and being accepted. Thus, there is a substantial bilateral commitment. Transferring from a Program, at any point, is actively discouraged. If there are issues with an individual mentor or a perceived lack of research laboratory options, it is expected that solutions will first be explored within the Program. Program transfer will only be approved under exceptional circumstances, and then only after successful completion of the preliminary exam at the end of the first year.

The following details are especially important to each new student.

- Establish a checking account as soon as possible. The University issues all paychecks, including student stipends, as automatic deposits. Students should be sure to have a voided check available when filling out payroll forms. Each student is required to produce a driver's license (or state ID) and a social security card for payroll purposes.
- New students immediately must obtain documentation to support the **Petition for State Residency**. Please click this link <https://www.cuanschutz.edu/registrar/residency/current-students> for information about residency as well as the form itself. First-year students must make collecting this documentation a priority. Funding will be available, assuming satisfactory academic progress, only if the student qualifies as an in-state resident after the first year of study.
- Tuition funding covers in-state tuition only, beginning with the fall term of the second year. Because the difference between in-state and out-of-state tuition is substantial, it is critical that you take all the necessary steps to gain state residency status immediately upon your arrival in Colorado. Beginning with the fall term of your second year, if you fail to qualify for in-state tuition, you will be responsible for the difference in cost between in-state and out-of-state tuition. NOTE: The above only applies to US Citizens and Permanent Residents. International students on F1 visas cannot qualify for in-state status.
- Everyone on campus must carry a CU Anschutz Badge. The Office of Research Education will facilitate the badging process for new students. This identification badge serves many purposes including enabling students to access university buildings and laboratories, utilize the library, obtain parking, and keep our campus secure. It is the student's responsibility to keep their badge on them and visible at all times. Lost or stolen badges should be immediately reported to the Badging Security Office or University Police (after hours).
- Announcements/Communications. Please be sure to note the announcements posted on the several bulletin boards located outside of the Graduate Training office, the HMGGP Administrative offices, and the Lounges. Email to your assigned cuanschutz.edu (domain address) is the primary form of written communication both within the Program and the University as a whole. Please check your email regularly: as a minimum, twice a day.
- When setting up your **first laboratory rotation**, please be sure to choose a mentor whose laboratory is located on the Anschutz Medical Campus. While there are Training Faculty members located throughout the several affiliated campuses, experience has taught us that commuting to another campus negatively impacts the performance of new students in their first semester. Third, or (under certain circumstances) second rotations may be done with mentors on other campuses.

GRADUATE STUDENT FINANCIAL SUPPORT

For first-year graduate students, stipend, tuition, and (individual) health and optional dental insurance benefits are generally supported by the Office of Research Education (ORE). Upon successful completion of the Preliminary Exam at the end of year one, and upon identification and acceptance into a thesis laboratory, students are supported by funds provided by their Thesis Advisors and/or by other external sources (i.e., fellowships and awards). Following the University Comprehensive Examination (generally at the end of the student's second year), the annual stipend during the thesis years is provided either by the student's Thesis Advisor or by external fellowships. Continuation of support is predicated at all times on satisfactory academic progress, as determined by the mentor, the Thesis Advisory Committee, and the Program Directors. The financial obligation for a student does not rest with the actual Human Medical Genetics and Genomics Program. Each student is responsible for his or her own books, housing, and any other expenses not specifically mentioned above. The Office of Research Education Administrator will obtain a copy of the first-year students' bills following registration for the current semester. The Administrator will ensure that all appropriate charges on the student bills are paid. It is only necessary to deliver a copy of the student bill to the Office of Research Education if there is a problem or question. Each student is personally responsible for late fees and fines, so it is critical that all necessary paperwork arrives at the Graduate Training office in a timely fashion and that all necessary registrations are completed. Moreover, any student registering past the semester registration deadline set by the Office of Admissions & Records will be assessed a late registration fee, which is also the student's responsibility by the explicit policy of the Assistant Dean of the Office of Research Education.

Student expenses, including the stipend, will be paid by the sources detailed above until graduation as long as the following conditions are met by the student:

1. Maintaining satisfactory academic progress
2. Achieving eligibility for in-state tuition after the first year. Students who fail to qualify for in-state residency will be responsible for the difference between in-state and out-of-state tuition
3. Passing the Preliminary Examination at the end of the first year. This requirement applies both to students who may be matriculating directly into the HMGGP degree Program and to students from the Biomedical Sciences Program (BSP) who intend to enter the HMGGP Ph.D. Training Program
4. Successful completion of the University Comprehensive Examination on or about the end of the second academic year. Students accepted into the Program as second-year degree candidates must pass the Comprehensive Examination at the end of their first year in the Program.
5. Ability of the student's chosen Thesis Advisor to provide support during the research phase of the Program.
6. Scheduling the Thesis Defense within approximately five years of entering the Program.
 - a. Office of Research Education rules require that a student defend their Ph.D. within eight years of matriculation. No extensions are permitted.
 - b. The NIH generally limits pre-doctoral support to seven years total.

ORE POLICY ON EXTERNAL EMPLOYMENT FOR GRADUATE STUDENTS

Background

Graduate students admitted to ORE Programs receive an annual stipend, health insurance coverage and full tuition. They are considered full time students and, per NIH policy, expected to devote a minimum of **40 hours** to their PhD training.

Students may wish to take on additional paid employment for financial reasons or to gain experience in teaching, industry or explore other career opportunities. This may be complementary and beneficial to their training and professional development in University of Colorado graduate programs.

Policy

Graduate students, as key personnel substantively involved in research related activities, are subject to the University of Colorado [conflict of interest and commitment](#) policy:

“With prior written approval by the dean or appropriate campus authority, faculty and staff members shall be permitted to receive additional remuneration from sources outside the university so long as the activities generating the income do not exceed one-sixth of their time and effort.”

In addition, [NIH policies](#) state:

“NIH recognizes that student or postdoctoral trainees may seek part-time employment coincidental to their training program to further offset their expenses. Fellows and trainees may spend on average, an additional 25% of their time (e.g., 10 hours per week) in part time research, teaching, or clinical employment, so long as those activities do not interfere with, or lengthen, the duration of their NRSA training.”

In accordance with the above policies, Graduate students, **in good academic standing**, may, **with appropriate approval**, work approximately **10 hours per week** in external employment.

Such employment must **be approved in advance**, by the Office of Research Education (ORE), the student’s Program Directors for first year students, and by Program Directors and Thesis advisor for those students who have entered a laboratory or who transfer or are directly admitted to a laboratory.

External employment must not conflict or interfere with any required elements of a student’s PhD training or lengthen that training. Examples include but are not limited to: laboratory research, classes, assessments, seminars, journal clubs, lab meetings, retreats and other required program or ORE activities.

Students **must remain in good academic standing** in order to continue their external employment.

Students receiving extramural support for their PhD from training grants or other sources are subject to the requirements and policies of those funding entities and may not be eligible for external employment.

Failure to disclose external employment, falsely reporting or willfully exceeding approved hours will be grounds for disciplinary action and possible dismissal from the PhD program.

Definitions

External employment- any paid (or compensated in kind) work or work product outside of a student’s PhD training program and the Office of Research Education.

Good academic standing-maintaining a minimum of a B grade in all classes, rotations and thesis work. Passing Preliminary and comprehensive exams. Meeting other Program requirements, as described in Program Handbooks. Demonstrating satisfactory and timely progress toward the PhD, as determined by the Student's Advisory/Thesis Committee.

Resolution of problems

Students may appeal denial or rescinding of approval for external employment, on the basis that policies were not followed or applied fairly. Appeals will be reviewed by the Associate Dean for Research Education and their decision will be final.

LEAVE POLICY

(From the NIH)

1. Vacation and Holidays - Trainees may receive the same vacations and holidays available to individuals in comparable training positions at the grantee or sponsoring institution (refer to the [Office of Research Education](#) website). Trainees shall continue to receive stipends during vacations and holidays. *At academic institutions, the time between semesters or academic quarters (including summer) is considered an active part of the training period, not a vacation.*

2. If student funding is obtained from a source other than the NIH, the other funding institution may provide leave guidelines that differ from those outlined above. In such cases, the guidelines from the relevant funding institution shall apply.

3. Sick Leave and Other Leave - Trainees may continue to receive stipends for up to fifteen calendar days of sick leave per year. Under exceptional circumstances, this period may be extended by the awarding component in response to a written request from the training Program Directors or the sponsor. Sick leave may be used for the medical conditions related to pregnancy and childbirth pursuant to the Pregnancy Discrimination Act (42 USC 2000 e (k)).

4. Parental Leave - Trainees may also continue to receive stipends for up to sixty calendar days of parental leave per year for the adoption or the birth of a child when those in comparable training positions at the grantee or sponsoring institution have access to paid leave for this purpose. Either parent is eligible for parental leave. For trainees, the use of parental leave must be approved by the training Program director. A period of terminal leave is not permitted and payment may not be made from grant funds for leave not taken.

5. Unpaid Leave - Individuals requiring extended periods of time away from their research training experience, which could include more than fifteen calendar days of sick leave or more than sixty calendar days of parental leave must seek approval from the awarding component for an unpaid leave of absence. Approval for a leave of absence must be requested in advance by the training grant Program Director and be countersigned by an authorized institutional official.

6. Leaves of Absence - During a leave of absence, documentation to suspend the period of appointment must be completed by submitting an amended Statement of Appointment Form and a Termination Notice. These forms should be submitted to the awarding component at the beginning of the leave. At the resumption of NRSA support, the reappointment must be documented on another Statement of Appointment Form.

DISCIPLINARY ACTIONS

The University of Colorado Anschutz Medical Campus, consistent with most other educational institutions, has a student honor code. The Human Medical Genetics and Genomics Ph.D. Training Program endorses and enforces this Academic Honor Code. The [Academic Honor Code](#) is found on the Office of Research Education website; all students are required to read the Academic Honor Code. Violations of the Academic Honor Code will be handled as detailed in the Academic Honor Code itself and may entail disciplinary action, up to and including dismissal from the Program and from the Office of Research Education.

Each student is expected to maintain satisfactory academic progress. A student whose grade point average drops below a 3.0 is placed on academic probation. To be removed from academic probation, a student must achieve a GPA of 3.0 or above for the academic semester following the semester for which the student was placed on probation and must achieve a cumulative GPA of 3.0 or above within two semesters of being placed on probation. A student who fails to be removed from academic probation within two semesters will be dismissed from the Program and the Office of Research Education.

The student requirements described in this handbook must be met by the deadlines stated. The Program Administrator will monitor the progress of each student. If a student is not meeting the Program's requirements in a timely manner, the Program Directors may request a meeting with that student. After review, the Program Directors may take any actions deemed appropriate, including placing conditions on the student's continuance in the Program or dismissing the student from the Program.

CURRICULUM IN HUMAN MEDICAL GENETICS & GENOMICS

The HMGGP graduate curriculum includes didactic courses, laboratory rotations, a seminar series, and a seminar-based discussion group. The heart of the first-year curriculum are basic core courses taken by all students in a number of different graduate Programs at CU, including Microbiology, Molecular Biology, Biochemistry, Cell and Developmental Biology, and Human Medical Genetics and Genomics during the fall semester. These courses serve as a basic science bridge to the more specific content of Human Medical Genetics and Genomics.

The main course in Human Medical Genetics and Genomics, designated HMGP 7600, is a four-credit, course taught in the spring semester of the first year by the Program faculty. HMGP7600 prepares first-year students for critically reading the literature and preparing and evaluating research grant proposals. Along the way, students are exposed to cutting-edge techniques and concepts from a variety of areas of research in Genetics and Genomics. The course is divided into four blocks. Blocks 1-3 are focused on specific topics (Genomics, Mendelian Diseases, and Complex Genetic Diseases) and are a mix of lectures with reading and analytical discussion of recent high-impact publications in these topic areas. In the 4th Block, students will learn grant-writing skills and will be required to write their own grant proposals which will be discussed in a mock “study section” forum at the end of the 4th Block.

All HMGGP students are required to complete one required course in statistics and one in bioinformatics by the end of their second year, even if they have had a previous course in statistics and bioinformatics.

The Office of Research Education requires at least 30 semester hours of course work (rotations and didactic courses) to be completed by the Comprehensive Examination and a total of 30 semester hours of dissertation (8990) to be completed by the Thesis Defense.

The student, in consultation with their Thesis Advisor and Thesis Advisory Committee, may select elective courses. These elective courses will be chosen based on relevance to the research Program of the student. These may include courses in any of the graduate Departments and Programs at UCD|AMC, courses in the curriculum for medical students, and in some cases courses elsewhere, such as CU-Boulder, to provide better background in topics relevant to the student’s training goals.

All HMGGP written assignments (including course homework, final exams, rotation papers, Preliminary Examination, Comprehensive Examination, Provisional Thesis) must be turned in via the University Canvas System (or other University online system if that is later changed). Students will certify that submissions are their own work, and submissions may be verified using the Canvas Turnitin plagiarism checker.

Regular attendance at the Human Medical Genetics and Genomics seminar series, the HMGGP journal club, and the HMGGP retreat is mandatory for HMGGP students throughout their graduate training. First, second, and third-year students are also required to enroll and participate in a discussion course based on the HMGGP seminar series (Topics in Human Genetics HMGP 7610), giving students the opportunity to interact one-on-one with world-renowned geneticists and engage in scientific discourse.

Beginning in their 2nd year, HMGGP students are required to give a half-hour presentation on their current research. These ‘research in progress’ talks will be given in an hour format, with 2 students presenting at each session. More senior students will start the presentations in the fall of each year.

The Doctor of Philosophy (Ph.D.) degree is the highest academic degree conferred by the University. To state the requirements of the degree in terms of credit hours would be misleading because the degree is not conferred merely upon the satisfactory completion of a course of study, however faithfully pursued. Students who receive this degree must demonstrate that they are proficient in some broad subject of learning and that they can critically evaluate work in this field; furthermore, they must have shown the ability to work independently in their chosen field and must have made an original contribution of significance to the advancement of knowledge.

LABORATORY ROTATIONS

2024 – 2025 Rotation dates

Rotation 1: Aug. 26 – Nov. 15

Rotation 2: Nov. 18 – Feb. 21

Rotation 3: Feb. 24 – May 16

Before selecting a Thesis Advisor, students will complete three 10-week rotations with members of the Human Medical Genetics and Genomics Program Training Faculty. Rotations can only be taken in laboratories of current HMGGP Training Faculty, except with special permission from the Program Director. **Rotations are arranged by discussion with the Program faculty member and in consultation with the GAC and final approval by the Program Director.** The student is responsible for contacting potential lab rotation advisors and scheduling his/her lab rotations in a timely manner. In extraordinary circumstances a fourth HMGGP rotation may be done during the summer, with permission of the Program Directors and the Dean of the Office of Research Education.

Research rotations provide students with the opportunity to sample a variety of different research experiences. The research rotations are designed to introduce students to different areas of research and methodologies, to teach a variety of approaches to scientific problem solving, and to provide the opportunity to explore various laboratories as potential homes for thesis research. Students should approach the research rotations with the specific primary goal of identifying their future Thesis advisor/laboratory.

There are several considerations that a student should keep in mind when choosing a rotation advisor. Rotations must be performed with a member of the Program Training Faculty. It is the student's responsibility to take the initiative to contact a rotation advisor and arrive at an agreement with the advisor in a timely manner. An individual faculty member may only have one HMGGP student doing a research rotation in his or her laboratory at any given time.

Each laboratory rotation requires:

- (1) Pre-rotation paper - A short (1-2 page) description of the rotation project by the end of the first week of the rotation. This description will be signed by the Faculty rotation mentor and will be turned in to the Program Administrator for the student's file.
- (2) Post-rotation paper - A final paper about the rotation project, results obtained, and interpretation/meaning (up to 5 pages), following the general format and organization of a research paper published in a peer-reviewed journal. This paper is due on the day after lab rotation seminar. This paper must be discussed with and signed by the Faculty rotation mentor and will be provided to the Program Directors for the student's file.
- (3) All Faculty members with rotation students are required to submit an online post-rotation report and grade at; <http://predocprogress.ucdenver.edu>.
- (4) Post-rotation seminar - At the completion of each required rotation, students must present a post-rotation seminar. This seminar will be presented on a predetermined Thursday during the regular HMGGP Seminar Series. The actual dates of the post-rotational seminar series for any given year are available from the Office of Research Education Administrator. In the post-rotational seminar, the student presents the rationale, methods, and results obtained from the rotation project, as well as an interpretation and a discussion of the rotation project results. The post-rotational presentation usually lasts fifteen to twenty minutes, with the last five minutes customarily devoted to questions from the audience.

MSTP students will follow the rotation guidelines of the MSTP Program.

ROTATION GRADES

Each rotation is assigned an initially suggested grade by the rotation advisor following the post-rotation seminar, as part

of the post-rotation report. The final rotation grade is assigned by the Program Directors based upon input from the Faculty rotation mentor and the GAC.

REGISTERING FOR LABORATORY ROTATIONS

Fall Semester HMGP 7650-001 and 7650-002 (1 credit each, 2.0 credits total)

Directed laboratory research in an area selected by the faculty. Students are required to take three rotations lasting one academic “quarter” each, starting in the fall semester of their first year. In the Fall semester, you must register for your first two rotations.

Spring Semester HMGP 7650-001 (1.0 credit)

Directed laboratory research in an area selected by the faculty. Students are required to take three rotations lasting one academic “quarter” each, starting late in the fall semester of their first year. Spring semester you will register for your final rotation.

BIOMEDICAL SCIENCES CORE COURSES

This is an interdisciplinary course required for first-year graduate students enrolled in basic science Ph.D. Programs at UCD|AMC. The objective of the course is to provide the basic science information and introduction to the skills required for a successful research career in all disciplines of modern biomedical sciences. Topics cover the fundamentals of biochemistry, molecular biology, cell biology, developmental biology, molecular genetics, and biomolecular structure. Specialty topics required by individual Programs are taken usually during the spring semester of the first year, and in some cases during the second year to round out the curriculum.

DIDACTIC COURSES

Students are expected to attend all lectures and to take detailed notes (Because parts of exams are “notes only”, your ability to do well in the course will depend in some measure on the accuracy of your notes. Using another student’s notes – because you have missed a lecture – while permitted, places you at a disadvantage in terms of understanding and applying the material covered in the lecture that you missed.) Students are also expected to do the assigned reading **prior** to the lecture.

ELECTIVE COURSES

Electives are courses that you and your Thesis Advisor and the Comprehensive Exam Committee decide you should have to broaden your knowledge and enhance your research. Check the [CU Anschutz Academic Catalog](#) for a list of offered courses along with the prerequisites and the semester in which each course is offered).

SEMINAR SERIES

During the fall and spring semesters, the Human Medical Genetics and Genomics Program sponsors a Seminar Series. Seminars are presented most Thursdays at 1 PM and cover a wide range of topics by distinguished speakers. Presenters include not only HMGGP and other UCD|AMC faculty members, but also renowned scientists from across North America and abroad. **All HMGGP graduate students are required to attend these Thursday seminars.** Attendance will be taken via sign-up sheets in the seminar room. Non-attendance at seminars must be approved in advance only by contacting the designated faculty member in charge of approvals (Dr. Kelly Sullivan for academic year 2024-25) via email (please cc Program Administrator). Students will also have the opportunity to visit with the speakers, and this is strongly encouraged. A formal post-seminar discussion course is required for 1st, 2nd, and 3rd-year students (Topics in Human Genetics HMGP 7610).

PROGRAM ANNUAL RETREAT

Every year the Human Medical Genetics and Genomics Program holds a retreat for faculty and student members of the Program. Presenters include HMGGP training and non-training faculty as well as student members. Attendance is required for all students; no absences will be excused, other than emergencies approved by the Program Director. All students in their second year and beyond are required to present at the Program retreat; student presentations include both poster and platform talks. First-year students are welcome to present, but it is not required.

JOURNAL CLUB

During the fall and spring semesters, the HMGGP students participate in a student-run journal club. The journal club schedule will be decided early in each fall semester. All HMGGP students are **required** to attend and participate in journal club, including presenting articles several times per year.

RESEARCH IN PROGRESS

Beginning in their 2nd year, HMGGP students are required to give a half-hour presentation on their current research. These 'research in progress' talks will be scheduled on Thursdays at 1 PM and given in an hour format with 2 students presenting at each session. More senior students will start the presentations in the fall of each year. Students will be assigned slots in the order of seniority. If a student is unable to present on their assigned date due to a conflict, it will be their responsibility to trade dates with one of their peers. In the event of a medical or family emergency, the student should inform the Program Administrator and Director as soon as possible, so that alternative arrangements can be made. Students in their 4th year and beyond who present a 30-minute talk at the program retreat may use the retreat talk as fulfillment of their research in progress talk requirement, with the approval of their thesis committee.

ATTENDANCE AT SCIENTIFIC CONFERENCES

Beginning in their 2nd year and after they have selected a thesis mentor, HMGGP students may (and are encouraged to) attend scientific conferences to present their research, either as a poster or platform talk. It is expected that any student in their 2nd year and beyond will attend ONE scientific conference annually and may request to be excused from attendance at required program activities specifically attendance at HMGGP seminars and after seminar meetings as part of HMGP 7610 (needs approval by HMGP 7610 Course Director – currently Dr. Kelly Sullivan) and classes (needs approval by respective Course Director). Students should be aware of the program calendar and get approval even before they submit an abstract if attendance at the meeting will affect their ability to attend program activities. Attendance at more than one scientific conference annually is rare and will be considered on a case-by-case basis for approval (by designated HMGGP Faculty member, Dr. Kelly Sullivan for academic year 2024-25).

Students in their 1st year are not approved for travel to scientific conferences as their primary commitment is to coursework, lab rotations and program activities during this time. Exceptions to this policy may be made for 1st year students under exceptional circumstances, requiring discussion and approval from Program Directors. Students should get Program and Course Director approval prior to registering for scientific conferences or making travel arrangements to avoid loss of registration fees and/or travel costs, as approval is not guaranteed.

Attendance at the program retreat is mandatory and approval will not be granted to attend conferences during those dates. As far as program seminars and courses go, approval will be granted on a case-by-case basis.

GOOD ACADEMIC STANDING

Students are expected to earn a "B" (3.0) or better in all required courses. Only in **exceptional** circumstances may a "B-" in a required course be acceptable, as determined by petition to the Program Director.

All AMC graduate students must maintain an average of "B" (3.0) or better in their course work. Students whose

cumulative GPA falls below 3.0 will be placed on Academic Probation by the Office of Research Education. They have two semesters in which to raise their GPA to 3.0 or above for removal from Academic Probation. The University of Colorado System Rules requires that after a student is put on academic probation, he/she must maintain a 3.0 in all subsequent semesters. Failing to meet either condition may be grounds for dismissal from the Office of Research Education.

The Human Medical Genetics and Genomics Program defines “good academic standing” as a 3.0 GPA or better without any grade lower than a "B" in any required course. Required courses with a grade of B- or lower cannot be counted towards Ph.D. requirements. The Program Directors will review students not in good academic standing at the end of each quarter. A "B-" or below in any required course is considered unsatisfactory academic progress and more than one "B-" or below may be grounds for dismissal from the Program.

A graduate student who receives an unsatisfactory grade in a course (a “B-“or below) may repeat that course once, upon written recommendation from the Program Directors and approval by the Office of Research Education (provided the course has not been previously applied toward a degree). The two grades received will be averaged in calculating the grade point average, and all grades received will appear on the student's transcript. The course may be counted only once toward satisfying the unit requirement for the degree. Any student who receives a grade lower than “B” in research will be immediately dismissed from the Program and the Office of Research Education.

PRELIMINARY EXAMINATION

There are two milestone examinations for each graduate student in the Human Medical Genetics and Genomics Ph.D. Training Program. The first examination, given at the end of the first year, is a Program administered **Preliminary Examination**. The second examination, given at the end of the second year, is the University-administered **Comprehensive Examination**.

The Preliminary Exam will consist of a written portion followed by a comprehensive oral exam administered by a Preliminary Examination Committee consisting of at least three HMGGP faculty members. The Committee will strive to achieve uniformity and fairness for both the written and oral examination. Written exams must be turned in by the time specified by the Committee. Oral exams for all students taking the exam will be scheduled during the first half of June. An overall grade of pass, fail or pass with conditions will be given, based approximately equally on the written and oral components, detailed below.

The Preliminary Exam (both written and oral sections) will have two parts. As specified by the Preliminary Exam Committee, each student will write a research proposal based on one of two provided papers. Each proposal is limited to 3-5 pages and will present and test at least one hypothesis derived from the findings in the paper. Each proposal should include the following: background, critical summary of the major findings and the significance of the findings, a future hypothesis that you propose, specific aims, and experiments to test your hypothesis. Each proposal must draw from everything that you have learned, not just what is in the papers. The focus will be on evaluating the student's ability for critical assessment of research findings, and the ability to propose and test a research hypothesis. The written proposals must be the student's own original work and must be submitted to the HMGGP office by the time specified by the Committee.

The purpose of the oral exam is two-fold. One is to test the student's ability to explain and defend the hypotheses and experiments proposed in their written proposal. Two, the written proposal will serve as a departure point to test the student's knowledge of human medical genetics and genomics and other relevant topics covered in graduate course work up to that point, including Core Course and HMGP 7600. The student will be expected to answer general knowledge questions on topics both related and unrelated to the proposal. The oral exam will last approximately one to two hours. It will begin with a brief (10 minute) summary slide presentation of the student's proposal, followed by a question period.

Written Proposal format:

Overall format: 1/2-inch margins; single-spaced; 12-point Times New Roman or 11 point Arial as the minimum font size; strict page limit of 3 pages total, not including references and cover page. The section limits below are only guidelines; you must decide for yourself how to optimally allocate 3-5 pages total.

Content format:

Background (up to 1 page): brief, focused summary of the literature relevant to the studies in the paper, including importance/significance of the topic and what prompted these studies to be undertaken.

Key findings and their Significance (up to 1/2 page): a critical (point out strengths and weaknesses) discussion of what the authors did and how they did it, the experimental findings in the paper, what do the findings mean or not mean, and why, and why this is important to the field.

PLEASE NOTE: It is not necessary that you accept the author's findings or agree with their conclusions. But whether you agree or disagree with the authors, you will need to defend your position with supporting evidence both in the written and oral sections.

Your (new) Hypothesis and two specific aims: addressing the next logical step in this line of investigation (i.e.: Given your assessment of the findings in this paper, what would you do to take this line of research to the next step, why that is important, and how would that advance knowledge?)

Experimental Design to address the Aims (up to 1 and 1/2 pages); for each Aim, discuss:

Rationale: Why do you propose these studies?

Experimental approach: What experiments will you do to accomplish the Aim? Give sufficient experimental detail to allow the reader to evaluate your understanding of the methods and whether those methods are applicable, feasible, and sufficiently definitive to achieving your stated Specific Aim. As appropriate, consider and discuss statistical power requirements.

Expected findings, possible pitfalls, possible alternative findings and interpretations, possible alternative approaches: What results do you expect; what could prevent the experiments from working the way you expect; what could you do if the experiments do not work the way you expect?

NOTE: If during your literature search, you find a paper that has already carried out an extension of this work, either by these authors or by other investigators, you must a) go no farther in reading that paper and b) chose a different Aim. You are on your honor in this regard.

HMGGP will accept the MSTP Preliminary Examination taken and passed by MSTP students who enter HMGGP and will accept the Preliminary Examination of any other CU-Denver Office of Research Education Basic Science Ph.D. Program taken by BSP students who enter HMGGP.

CHOOSING YOUR GRADUATE RESEARCH THESIS LABORATORY

The selection of a Thesis Advisor is one of the most important decisions a student will make during the course of her or his graduate career. Each student must select a Thesis Advisor from among the Human Medical Genetics and Genomics Training Faculty. An updated list of Training Faculty can be obtained from the Human Medical Genetics and Genomics [website](#). The first year of the training Program is designed to provide each student with an opportunity to interact with the faculty so that she or he feels familiar with the faculty members and their respective research interests. The student should know which laboratory she or he wishes to enter on or about the date of the Preliminary Examination; however, a Thesis Advisor may be selected at any time during the first year, ideally no later than May 31st. The student should inform the Program Administrator and Director as soon as they have identified their thesis mentor in order to complete the required paperwork. A faculty member may have only two *Human Medical Genetics and Genomics* graduate students doing thesis research concurrently. The entry of a third HMGGP graduate student into a thesis laboratory is contingent on the approval of the Program Director. In the unlikely event that a student is unable to select a Thesis Advisor before the beginning of the Fall semester of the second year of graduate training, the Human Medical Genetics and Genomics Program reserves the right to dismiss the student from the Program.

COMPREHENSIVE EXAMINATION COMMITTEE AND EXAM

Students are required to pass a comprehensive qualifying examination to advance to candidacy for the Ph.D. The Comprehensive Exam Committee (CEC) will administer the student's comprehensive qualifying exam, **during the fall semester at the beginning of their third year, no later than October 1.**

COMPREHENSIVE EXAMINATION COMMITTEE (CEC): COMPOSITION, TIMELINES, AND OTHER GUIDELINES

The student and their Thesis Advisor will provide to the Program Directors the composition of a proposed Comprehensive Exam Committee (CEC) no later than FIVE MONTHS after the student has selected a thesis laboratory and advisor (by November 1 of their second year). The CEC will consist of a Chair who must be a member of the HMGGP Graduate Training Faculty, the Thesis Advisor, and at least three other members of the University of Colorado Denver Graduate Faculty Directory, https://gs.ucdenver.edu/tbl_gradfac_curr.php, at least one of whom must NOT be a member of the HMGGP Graduate Training Faculty. The proposed CEC must be approved by the Program Director. The student must take the initiative in obtaining these approvals.

Students must meet with their Comprehensive Exam committee at least once before the exam. This meeting can be held soon after the formation of the CEC, but no later than April 1. The purpose of this meeting is for the student to introduce his/herself to the CEC and to provide a general introduction to the student's future thesis work. This meeting must not be used as a "practice" session for the exam. Thus, committee members must refrain from suggesting their own testable hypotheses and experimental design strategies. Students are permitted to meet their CEC as may be necessary to address emergent issues in the student's progress.

COMPREHENSIVE EXAMINATION: REQUIREMENTS, TIMELINES AND OTHER GUIDELINES

Prior to scheduling the Comprehensive Exam, students must have completed all required course work, including the minimum number of elective credit hours (a total of 30 credit hours, not including HMGP 8990). Students must obtain a Ph.D. *Application for Candidacy form and a Request for Scheduling Exam form from the Office of Research Education, which must be completed and submitted to the Office of Research Education at least four weeks in advance of the scheduled examination date.* Students must be registered for at least five thesis credit hours during the semester in which the examination is taken. The student must submit the Comprehensive Exam paperwork to the Program Director, for review and approval, no later than four weeks prior to the exam date. Once approved, please return your paperwork to the Office of Research Education Office, no less than four weeks prior to the examination date.

The Comprehensive Examination itself is a formal requirement of the University, Office of Research Education, and Program. The Comprehensive Examination is the second formal major steppingstone towards the Ph.D., after the Preliminary Examination, and is explicitly meant to assess whether or not a student should be permitted to continue towards candidacy for the Ph.D. degree. The HMGGP Comprehensive Examination constitutes the formal proposal for the intended Ph.D. work. The specific format of the Comprehensive Exam will consist of the student preparing the thesis proposal, written in the format of a NIH-type F31 (NRSA) grant proposal (minus the training component description, budget, etc.). Students will only need to submit a ONE-page Specific Aims and a SIX-Page Research Strategy, which includes Background, Significance, Innovation, and Experimental Approach. Figures should be included in the SIX-page text. References/Literature Cited are separate and do not count towards the SIX-page Research Strategy limit.

While it is inevitable that the Thesis Advisor will have some input in the student's proposed thesis work, it is required that the Comprehensive Examination largely be the student's own work, so as to test the student's ability to organize their thinking, formulate ideas, hypotheses, and plans, design practical experiments to test those hypotheses, and present those effectively in both the written and oral contexts. The proposal must be prepared by the student without direct input from the Thesis Advisor, who is not permitted to preview the written proposal the student submits for the examination.

The student must submit the written proposal to the CEC no later than 2 weeks prior to the examination date or the examination will be automatically canceled and must be rescheduled. The proposal will be reviewed by the CEC and will be followed by an oral examination administered by the Committee that will be based on the thesis proposal. However, the nature of a "comprehensive exam" requires that the student be prepared for the examination to cover a wide range of relevant topics in human genetics.

GUIDELINES FOR THE COMPREHENSIVE EXAMINATION

1. The Human Medical Genetics and Genomics Program requires that the Comprehensive Exam topic must be related to the future thesis topic; constituting the final Proposal for thesis research.
2. Students must obtain prior written approval of their topic from the Program Director, as well as the members of their CEC.
3. The CEC is composed of five members (including your Thesis Advisor), at least three of whom must be HMGGP Graduate Training Faculty. One of the members must be a non-HMGGP faculty member. The Chair of the Committee must be a member of the HMGGP Graduate Training Faculty and your Thesis Advisor must be a member.
 - Per the Office of Research Education - Policy on Conflict of Interest and Undue Influence for Thesis Committees: "To ensure independent evaluation of students' progress and examinations, and provision of impartial advice and guidance, no member of the committee should have undue influence over another member of the committee or the student. Undue influence could include, but is not limited to, direct employment (e.g. a postdoc employed by a faculty member), familial, domestic or amorous relationships, financial relationships or significant scientific collaboration (e.g joint funding). Any potential conflicts must be disclosed by committee members to the student, the committee and ORE and a plan to mitigate them approved by the Program Director and ORE Assistant Dean for Student Affairs. Familial, domestic or amorous relationships, perceived undue influence or other potential conflicts of interest, involving a prospective committee member and the Thesis Advisor(s), Committee Chair and/or Student, may prohibit that prospective member from serving on and/or being a voting member of said committee. If necessary, the Program Director and ORE Assistant Dean for Student Affairs will review and adjudicate potential conflicts."
<https://medschool.cuanschutz.edu/docs/officeofresearcheducationlibraries/default-document-library/ore-policy-on-conflict-of-interest-and-undue-influence-6-1-24.pdf>
 - In addition, the HMGG Program requires that the Committee Chair should not have shared research funding or significant scientific collaborations with the Thesis Advisor. If such relationships emerge during the student's training, then the student is advised to appoint another committee member to serve as Chair. Co-mentorship on a student's F31 fellowship is not considered shared research funding.
4. The proposal must be distributed to the Committee at least two weeks prior to the Examination date.
5. The proposal should follow standard NIH-type F31 (NRSA) grant application format. It is anticipated that the Comprehensive Exam proposal may thus constitute the basis for a subsequent formal NRSA submission. Students are encouraged to submit their proposals as part of NIH-type F31 applications soon after their Comprehensive exam.
6. The timeframe of the proposed work should be such that the work could be completed in 2-3 years (similar in nature to a pre-doctoral or post-doctoral fellowship grant such as an NRSA).
7. Students will need to spend a significant period of time reading the primary literature related to the topic and be able to summarize its relevance to their own proposal.

8. While the topic of the proposal is the Proposal for the student's thesis project, it is understood that the Proposal is the product of the student, not the mentor. It is not appropriate or permitted for students to “cut and paste” from their mentors’ or colleagues’ R01 or other grants/papers to obtain a basis for their own grant proposals or to otherwise plagiarize existing work. Students may discuss ideas, aims, and approaches with mentors, however. The intent is for students to compose and defend a unique, independent, and defensible product.
9. Students will schedule 2 ½ hours for the examination. The examination format is a 20-minute, oral, formal summary of the proposal by the candidate. This is also an opportunity for the candidate to clarify any changes in thinking between submittal of the Proposal and the actual defense. The exam continues with the Committee questioning the candidate. At the conclusion of the questioning, the candidate is dismissed, and the Committee goes into private session to discuss and determine the evaluation of the examination. No more than one member of the Committee may “attend” via Skype or other videoconferencing modality. The Thesis Advisor, Committee Chair, and student must be physically in the room.
10. The Office of Research Education guidelines stipulate that the University Comprehensive Examination is pass/fail only. Failure requires termination from the Program. A “pass with contingencies” as dictated by members of the CEC is acceptable. The Committee may decide for any reason to have a continuation of the examination, which may be written, oral, or both.
11. The CEC Chair will prepare a final report of the examination under Comprehensive Examination Assessment at <https://gs.ucdenver.edu/gaia/pprog/nav.php>
11. On the student's passing the Comprehensive Exam the CEC will be dissolved.
12. No part of the HMGGP Comprehensive Examination is open to the public.

ROLE OF THE THESIS ADVISOR AND COMMITTEE MEMBERS IN THE COMPREHENSIVE EXAMINATION

The Comprehensive Examination is an exam of the student. Committee members must refrain from suggesting their own testable hypotheses and experimental design strategies that might effectively interfere with the Comprehensive Examination. The Thesis Advisor is a full member of the Comprehensive Examination, with some limitations. The Thesis Advisor does vote as to the outcome and should take part fully in the discussion before and after the examination segments. The Thesis Advisor should not help or coach the student during the examination; neither should they correct any mistakes the student might make or help fill gaps. The Thesis Advisor may offer limited background if granted permission by the Committee Chair and may answer questions of clarification if the Chair feels they are appropriately directed to the Thesis Advisor, but these would be exceptional; the Advisor should keep answers to the point and avoid extended discussion. During the Comprehensive Examination, the Advisor may ask the student questions just as any other member of the Committee.

HMGGP COMPREHENSIVE EXAM AND CONSIDERATIONS FOR PROPOSALS SUBMITTED TO EXTERNAL GRANTING AGENCIES PRIOR TO COMPREHENSIVE EXAMINATION

HMGGP encourages students to apply for external and internal funding opportunities. We recognize the value of the exercise of crafting a grant proposal and, for the sake of their student's education, we expect the PIs to come up with ways to ensure that students benefit from this experience.

If the student plans to submit proposals prior to taking the Comprehensive Exam, the following guidelines must be followed:

- The grant proposal document can serve as the Comprehensive Exam written proposal. This must be explicitly

stated in the Comprehensive Examination document submitted, with a paragraph describing the student's input and the PI's input.

- The Comprehensive Exam proposal should primarily reflect the student's effort, though we recognize that the external grant proposal might have considerable input from the P.I. and that the P.I. will have read and made comments to enhance its competitiveness.
- Accordingly, the student should be aware that the CEC will expect a much higher level of response to questioning in the oral portion of the Comprehensive Exam.
- If a student is able and plans to submit a grant proposal in the summer of Year 2, then the student should take the Comprehensive Exam before this time.

THESIS ADVISORY COMMITTEE

THESIS ADVISORY COMMITTEE (TAC): TIMELINE AND COMPOSITION

The student must select a Thesis Advisory Committee (TAC) soon after passing the Comprehensive Examination, no later than December 15th. It is strongly recommended that the TAC be substantially the same as that of the Comprehensive Examination Committee (CEC). The TAC must consist of five members, at least four of whom must be UCD|AMC faculty with graduate faculty status, at least three of whom must be members of the Human Medical Genetics and Genomics Program Training Faculty. One of the members must be a non-HMGGP faculty member. This allows for one member who is external to the UCD|AMC faculty, as may be appropriate for the inclusion of Committee members with special expertise, if appropriate. The Chair must be a member of the HMGGP Graduate Training Faculty. The Committee membership may be greater than five, but a majority of the Thesis Advisory Committee must be members of the HMGGP Graduate Training Faculty, which may require appointment of additional HMGGP Training Faculty to the Committee. The membership of the Committee must be approved in writing by the Program Director.

Per the Office of Research Education - Policy on Conflict of Interest and Undue Influence for Thesis Committees “To ensure independent evaluation of students’ progress and examinations, and provision of impartial advice and guidance, no member of the committee should have undue influence over another member of the committee or the student. Undue influence could include, but is not limited to, direct employment (e.g. a postdoc employed by a faculty member), familial, domestic or amorous relationships, financial relationships or significant scientific collaboration (e.g. joint funding). Any potential conflicts must be disclosed by committee members to the student, the committee and ORE and a plan to mitigate them approved by the Program Director and ORE Assistant Dean for Student Affairs. Familial, domestic or amorous relationships, perceived undue influence or other potential conflicts of interest, involving a prospective committee member and the Thesis Advisor(s), Committee Chair and/or Student, may prohibit that prospective member from serving on and/or being a voting member of said committee. If necessary, the Program Director and ORE Assistant Dean for Student Affairs will review and adjudicate potential conflicts.”

<https://medschool.cuanschutz.edu/docs/officeofresearcheducationlibraries/default-document-library/ore-policy-on-conflict-of-interest-and-undue-influence-6-1-24.pdf>

- In addition, the HMGG Program requires that the Committee Chair should not have shared research funding or significant scientific collaborations with the Thesis Advisor. If such relationships emerge during the student’s training, then the student is advised to appoint another committee member to serve as Chair. Co-mentorship on a student’s F31 fellowship is not considered shared research funding.

THESIS ADVISORY COMMITTEE (TAC) MEETINGS: TIMELINE AND GUIDELINES

No more than 6 months after the Comprehensive Exam, each student will schedule their first TAC Meeting outlining their proposed thesis research project including rationale and methods of approach. Thereafter, the student meets with their TAC annually. Students must take the initiative in scheduling TAC meetings. TAC meetings provide both the student and the advisor with an opportunity to receive ideas and criticism from a broad spectrum of individuals, ensuring that the proposed project is both suitable and achievable.

The student must submit a written Progress Report (not to exceed 3 pages) to the Committee at least 1 week before the Committee Meeting. The report should contain the following items: 1) the student’s proposed Specific Aims; 2) the progress made on each Aim since the last Committee Meeting; 3) any proposed changes in research direction along with justification; 4) brief summary of experiments proposed over the next 6 months; and 5) a list of manuscripts in preparation and proposed dates for submission/publication.

No more than one Committee members may “attend” via Zoom or other videoconferencing modality, though the Thesis Advisor, Committee Chair, and student must be physically in the room.

The Chair must keep records of these meetings, including; time, date, place, attendees, overview of material discussed

and recommendations to student; a TAC Meeting Summary report must be prepared by the Committee Chair under Thesis Meeting Assessments at <https://gs.ucdenver.edu/gaia/pprog/nav.php> within one week of the meeting. Students must take the initiative in ensuring that required reports have been submitted.

The TAC will determine when a student is deemed prepared to write, present, and defend the Ph.D. thesis. The Committee will attend the public thesis defense and will subsequently administer a final oral examination based on both the written thesis and on the public defense.

The Research in Progress seminar is presented on an annual basis by each student. Research in Progress seminars provide a good opportunity for the student's TAC to review the student's progress and to invite input from the faculty as a whole, as well as afford the student opportunities to hone and polish presentation skills. The Research in Progress seminar is not in place of your mandatory TAC meetings. Meetings with the TAC are mandatory; failure to meet within the recommended time frame will result in denial of registration for the next academic semester.

THE DOCTOR OF PHILOSOPHY DISSERTATION

The Ph.D. dissertation will follow the rules of the University of Colorado and the Office of Research Education. The dissertation is partial fulfillment of the requirements for the degree of Doctor of Philosophy and is based on original research demonstrating mature scholarship, critical judgment and familiarity with the methods of research. The quality of the work is to be that maintained by peer-reviewed journals in the field.

The Program Directors and Thesis Advisory Committee (TAC) prior to the dissertation defense must approve the dissertation. The student must be registered for five thesis credit hours in the semester of the thesis defense and must fill out required forms for the scheduling of an examination at least 4 weeks before the examination date; these forms can be obtained from the Office of Research Education Office or at <http://www.ucdenver.edu/academics/colleges/Graduate-School/current/Pages/resources.aspx>

It is required that the Thesis Advisor read, critique, and approve the Thesis prior to its submission to the TAC. The student should therefore provide the Thesis (complete or in parts) to the Thesis Advisor with sufficient time to allow reading, comments, and revision prior to submission of the Thesis to the rest of the Committee. Subsequently, each member of the TAC must receive a finalized draft of the thesis at least two weeks before the examination date, or the exam will be automatically canceled and must be rescheduled.

Students will schedule a minimum of three hours for the Thesis defense. The Thesis defense date must be scheduled so as to not conflict with other major Program activities, such as Program seminar dates. The first hour will consist of a one-hour public Thesis summary seminar presentation; this seminar is designed to present the Thesis project to the Faculty and the University community as a whole. This seminar will be prior to the defense examination.

It is expected that all Thesis Committee members will attend the public presentation and subsequent Examination “in person”. In the event of compelling or emergent events, no more than one Committee member may “attend” via Skype or other videoconferencing modality with the approval of the Program Director; scheduling convenience will not be considered a sufficiently compelling or emergent reason. The Thesis Advisor, Committee Chair, and student must be physically in the room.

The Examination portion of the Thesis defense is held immediately after the public Thesis summary seminar presentation. While the Examination is technically also open to the public, it is not encouraged that others except for the TAC attend. For the Thesis defense examination, the Committee will question the student about the work or other matters that may arise. In order to pass the examination, the student must receive affirmative votes from the majority of the members of the Committee. The Thesis Advisory Committee, like Comprehensive Examination Committee, may impose conditions before conferring a pass.

The student must submit to the Office of Research Education and his/her Program a completed and approved library copy of the Thesis and appropriate additional documents, in the format and time frame required by the University of Colorado. The Office of Research Education holds regular training sessions to go over the guidelines.

PUBLICATION REQUIREMENTS FOR THESIS DEFENSE

At least one primary, first author research paper, resulting from the student's thesis project in their mentor's laboratory, must be submitted and under review at the time of thesis defense. The TAC will not approve a thesis defense until these criteria are met. The program encourages students to publish as many papers as possible for better career options after graduation.

ROLE OF THE THESIS ADVISOR IN THE THESIS DEFENSE

The Thesis Advisor is a full member of the TAC, with some limitations. The Thesis Advisor does vote as to the outcome and should take part fully in the discussion before and after the examination segments. The Thesis Advisor should not

help or coach the student during the examination; neither should they correct any mistakes the student might make or help fill gaps. The Thesis Advisor may offer limited background if granted permission by the Committee Chair and may answer questions of clarification if the Chair feels they are appropriately directed to the Thesis Advisor, but these would be exceptional; the Advisor should keep answers to the point and avoid extended discussion. During the Thesis Defense, the Advisor may ask the student questions just as any other member of the Committee.

CLARIFICATION OF OFFICE OF RESEARCH EDUCATION RULES FOR EXAMINATION RESULTS

(Subject to change)

PASS

You must receive the affirmative votes of a majority of the members of the committee in order to pass.

- You will need to pay attention to the rules regarding registration for the correct number of thesis hours in the semester during which you will take the comprehensive exam in order to be eligible for it.

PASS WITH CONDITIONS

The committee may feel that, although you have passed the examination, you should complete additional work. This may be in the form of rewriting submitted work, additional coursework, etc. These conditions must be satisfied within six months. You will be considered to have "passed" when these conditions are met. Failure to meet the conditions will result in failure of the examination.

- You should register for thesis hours as if you had passed without conditions (see the notes under PASS above).

FAIL

In the event that you fail the examination, you are subject to immediate dismissal from the Office of Research Education. At the discretion of your Program, you may be allowed to retake the examination once. The remedial exam will be in a form designated by the committee and must be completed within the stipulated timeframe recommended by the committee.

TIME TO PH.D. DEGREE

The Human Medical Genetics and Genomics Program encourages students and mentors to work towards a timely graduation. While the Office of Research Education permits a total of eight years to complete requirements for the Ph.D. degree, the Human Medical Genetics and Genomics Program requires that the Ph.D. be attained in no more than seven years from matriculation. Extensions under extraordinary circumstances will be at the discretion of the Program Director.

DISCLAIMER

This handbook, which includes parts of the Office of Research Education Rules, does not constitute a binding contract, either expressed or implied, with the University of Colorado Anschutz Medical Campus Office of Research Education nor with the Human Medical Genetics and Genomics. Both the Office of Research Education and the Human Medical Genetics and Genomics Ph.D. Training Program reserves the right at any time to change, delete, or add to any of its provisions or contents at their sole discretion. Furthermore, the provisions outlined in this document are designed to serve as firm guidelines rather than absolute rules and exceptions may be made based on extenuating circumstances.

APPENDIX 1

GUIDELINES FOR CHOICE OF STATISTICAL COURSEWORK

Statistics offers many important tools for use in the biological sciences. Whether the task at hand is to understand studies that have been conducted or reported in the literature, to design and conduct a new study, or to correctly analyze data, statistics informs the appropriate interpretation of the results with an understanding of the implications for future research. Depending on your research and professional plan and your background in mathematics, there are multiple options for courses in statistics at the University of Colorado Denver. Guidelines are given below, separated into three scenarios depending on your research needs.

SCENARIO 1: Your research will not involve large collections of data, although it will require the ability to read and critique the scientific literature, formulate hypotheses based on current concepts in the field and design, conduct, and interpret your own research projects.

BIOS6606 Statistics for the Basic Sciences (3.0 cr.) (Fall) Restrictions: Enrollment in UCD-AMC graduate program or permission of the instructor. This course provides an overview of fundamental concepts in statistics such as hypothesis testing and estimation, and it provides an overview of statistical methods (for example, regression and analysis of variance) that apply to many areas of science.

SCENARIO 2: Your research will not involve large collections of data, although it will require the ability to read and critique the scientific literature, formulate hypotheses based on current concepts in the field and design, conduct, and interpret your own research projects. But you are interested in exposure to more statistical methods than those offered by a single course.

BIOS6601 Applied Biostatistics I (3.0 cr.) (Spring, Summer, Fall) Applied biostatistical methods including descriptive and statistical inference; odds ratio and relative risk, probability theory, parameter estimation, tests for comparing statistics of two or more groups, correlation and linear regression and overviews of: multiple and logistic regression and survival analysis.

BIOS6602 Applied Biostatistics II (3.0 cr.) (Spring) Prerequisite: BIOS6601. A continuation of BIOS6601 extending the basic principles of descriptive and inferential statistics of modeling more complex relationships using linear regression, logistic regression, and Cox regression. The statistical package SAS is used extensively.

SCENARIO 3: Your research will involve collection and/or analysis of large sets of data. Beyond the ability to read and critique the scientific literature, formulate hypotheses based on current concepts in the field and design, conduct, and interpret your own research projects, you will be involved in conducting statistical analyses. In addition, if you are interested in courses in the area of statistical genetics or genomics, these are prerequisites for many such courses.

BIOS6611 Biostatistical Methods I (3.0 cr.) (Fall) Prerequisite: Differential calculus. This is a first course in applied statistics covering elementary probability, descriptive, parametric, and non-parametric methods for one and two sample estimation/testing and some common simple cases of the univariate general linear model. The statistical package SAS is used extensively.

BIOS6612 Biostatistical Methods II (3.0 cr.) (Spring) Prerequisite: BIOS6611. This is a continuation of BIOS6611 covering univariate linear modeling and emphasizing multiple regression and analysis of variance. Logistic regression and methods for correlated data are also covered. Matrix algebra and the statistical package SAS will be used.

FURTHER STUDY: There are a variety of additional advanced courses for those interested in building their quantitative skills. A more comprehensive list of courses in Statistics across the three CU campuses is available upon request for interested students. Many of these require BIOS6611/BIOS6612 as prerequisites.

APPENDIX 2

GUIDELINES FOR CHOICE OF BIOINFORMATICS COURSEWORK

In addition to knowledge of biostatistics, practical skills in bioinformatics are needed by the majority of HMGG students for their research projects and are viewed as an essential piece of training in genetics and genomics. Most students, whether working on large scale human genetics and genomics studies or in laboratories that use animal models for functional and evolutionary genetics studies will need basic bioinformatics skills in Unix, Python, and R for analysis of datasets such as RNA-seq, for example. To satisfy the 3 credit hour requirement in bioinformatics, students can take any of the following courses.

IDPT 7810-007 (Fall Year 1 as part of Core Course; 1.0 cr.) Practical Data Analysis with R/RStudio.

In this short course you will learn to analyze and visualize complex data sets using the R statistical programming language and the RStudio IDE. We will use common biological experiments to illustrate analysis strategies including the study of mRNA expression and isoforms, histone post-translational modification in the context of chromatin and cell-type characterization using single cell approaches.

MOLB 7900: Practical computational biology for biologists: Python (Spring every year; 2.0 cr.)

This is a computational biology class aimed at biology PhD students. Topics covered include: basic practices for coding in Python; analysis of standard high-throughput genomic data to study the regulation of gene expression; integration of multiple datasets for genomic analysis; introduction to scientific computing in Python.

MOLB 7910: Practical computational biology for biologists: R (Spring every year; 2.0 cr.)

This is a computational biology class aimed at biology PhD students. Topics covered include: basic practices for coding in R; analysis of standard high-throughput genomic data to study the regulation of gene expression; introduction to modeling gene expression; data visualization; how to communicate computational analysis/results.

BSBT 6112: Introduction to Biocomputing (Fall every year; 2.0 cr.) (This course must be taken together with BSBT6113: R and tidyverse. 1.0 cr. See below) for a total of 3 cr.

This course provides students with hands on experience in basic computation, database, and programming skills set as a preparation for a higher-level data analysis course. The students will start by learning the fundamental of data science; database management, data structure, data representation, data visualization, and data analysis. Once they have a good grasp of these concepts, they will learn to program these abstractions using command line interface software such as shell scripting, SQL, R and RStudio. At the completion of the course, students will be able to reimplement a computational pipeline from a published journal using the reproducible research paradigm.

BSBT6113: R and tidyverse (Fall every year; 1.0 cr)

This course provides students with a semi-independent learning environment to study the "tidyverse" data science computational framework. This month-long course will train students to become an effective self-learner with amber instructions and guidelines. Students will be assigned designated book chapter(s) to read each class to learn the basic concept of R and the tidyverse framework. We will meet twice every week to review the chapter's exercises to clarify any questions or confusions. In addition, students will be assigned screencast video watching assignment to learn how experts in different fields used the framework to solve real world problems. At the completion of the course, students will be competent in using the "tidyverse" methodology to wrangle tabular data and perform rudimentary data analysis.

In addition to these courses, there are other options available (same or more advanced level) through other programs in the Graduate School and the Colorado School of Public Health. Students who are interested in alternative course offerings should contact Dr. Tzu Phang, a member of the Graduate Advisory Committee (GAC), who is available to advise HMGGP students on bioinformatics course offerings. In the event that a student completes 2.0 cr and is unable to register for another course to reach the 3.0 cr requirement, a student may obtain permission from the Program Directors and Curriculum Committee Chair to complete an online course to satisfy the remaining 1.0 cr. Specific online course choice

must be discussed with Dr. Phang and approved by him prior to registering. Online courses available at no fee through the CU Portal Training page (LinkedIn, CU Coursera, or Coursera Consortium courses) are available for this purpose.