Cell Biology, Stem Cells and Development Program

GRADUATE SCHOOL

UNIVERSITY OF COLORADO
DENVER | ANSCHUTZ MEDICAL CAMPUS

STUDENT HANDBOOK

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https://www.cuanschutz.edu/graduate-programs/cell-biology-stem-cells-and-development/home

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I. Mission

The primary goal of the **Graduate Program in Cell Biology, Stem Cells and Development** (CSD) is to train talented scientists in cell and developmental biology. The Program strives to attract outstanding students with the highest potential, and to provide them with quality training that stimulates independent and creative scientific thinking; ultimately helping students to develop their full potential in becoming independent investigators and leaders in biological science.

The CSD Program is committed to promoting an inclusive and equitable training environment that embraces diversity, eliminates structural biases from recruitment and training, and supports the identities and values of our students.

Program/Student Learning Outcomes: The CSD Program trains graduate students to become

proficient and successful investigators who are able to:

1. Demonstrate a basic knowledge of central concepts in the biomedical sciences.
2. Understand the current concepts in Cell Biology, Stem Cell Biology and Development.
3. Read and critically evaluate the scientific literature.
4. Formulate hypotheses based on current concepts in the field and design, conduct, and interpret their own research projects.
5. Present research results in peer-reviewed publications and in a dissertation.
6. Communicate research results effectively through oral presentations at scientific seminars, conferences, and other venues.
7. Write a competitive application for research funding.
8. Develop ancillary skills, where necessary, to obtain positions outside of scientific research.

The Program's emphasis is on the definition and resolution of biological problems rather than the application of technologies. Thematically, the program is focused on cell, stem cells and developmental biology and offers a wide range of research opportunities. The nature of this program will best serve those students who are interested in developing independent research careers and who wish to pursue problems in biomedical science from an interdisciplinary perspective.

After the initial period of coursework, students choose their specialty fields from a diverse list of topics, and proceed with research until the generation and defense of a thesis leads to the award of a Ph.D. in Cell Biology, Stem Cells and Development.

II. Office of Research Education

The Office of Research Education (ORE) PhD programs are affiliated with the University of Colorado Anschutz Medical Campus Graduate School. The Office of Research Education (ORE) resides within the Office of Medical Education (OME) within the School of Medicine (SOM). ORE serves as the administrative home for 1 umbrella-admitting program, Biomedical Sciences (BMSC), and 12 PhD granting programs. As affiliated-programs, ORE PhD programs must comply with the Policies and Procedures of the CU Anschutz Graduate School. ORE has prepared an annotated version of the GS Policies and Procedures available at https://medschool.cuanschutz.edu/ore/forms-and-resources.

The CU Anschutz Graduate School makes their policies available on their website. This guide includes general information and policies concerning graduate students, as well as specific information on Honor Code and Grievance Procedures. This information applies to students in all programs: https://graduateschool.cuanschutz.edu/forms-resources/resources

The purpose of this handbook is to relay additional information specific to the CSD program.

Student Support.

At present, students accepted in the Ph.D. program are provided full tuition, health insurance, and a stipend of $38,110 per year for living expenses (for the academic year 2024-25). Continued support is contingent upon satisfactory academic and research performance by the student. When a student enters a thesis lab, the thesis mentor assumes complete responsibility for the

student's stipend, tuition, fees, and associated research costs. In order to qualify for in-state tuition for the following year, **all out-of-state students must establish Colorado residency by the end of summer of the first year.** See the Registrar's website for complete details: https://www.cuanschutz.edu/registrar

Student Advising.
During the first year, CSD students will meet with members of the Graduate Advisory Committee (GAC) on a rotating basis to discuss the student's progress in the CSD Program and any questions that may come up. Students will be expected and encouraged to seek advice from the GAC, Director, and/or other CSD faculty and student members prior to lab rotations, Comprehensive Examination, and any other situation requiring faculty consultation.

Transfer Credits.
Please see the Graduate School's "Policies & Procedures Guide" for information about transferring credits towards your degree with the Cell Biology, Stem Cells & Development PhD program. That guide is available on the Graduate School website under the "Resources" tab: https://graduateschool.ucdenver.edu/forms-resources

III. Program Components

1ST YEAR STUDENTS

COURSEWORK, LABORATORY ROTATIONS, AND PRELIMINARY EXAMINATION

A. COURSES

Fall Semester - Required Registration

Foundations in Biomedical Sciences – Section 001
BMSC 7806 6 units
Course Director: Drs. C. Musselman, L. Heasley, K. Fantauzzo, R. Prekeris, C. Pearson, J. Moore
This section of the course covers basic biochemistry, molecular biology, genetics, and cell biology.

Core topics in Biomedical Sciences
BMSC 7810 Sections 001-010
First year students will register for two sections, one section in Core Topics A (Section 001-005) and one section in Core Topics B (Sections 006-010). Each section is a 3 week intensive special topics course, the Core Topic A sections start immediately after BMSC 7806 followed by Core Topic B sections. Course offerings vary by year but includes topics courses in immunology/microbiology, stem cell and regenerative medicine, developmental biology, cancer biology, and exploratory data analysis in R/R Studio. An updated list of the course offerings will be provided to students prior to registration in the fall. CSD are **strongly encouraged but not required** to take the section offered by the CSD program, "Stem Cell Biology to Regenerative Medicine" and "Intro to Animal Models & Experiments in Developmental Biology"; see descriptions below. First-year students who would like to take Core Topics offerings other than the options that are strongly encouraged should consult with the Program Director prior to enrollment.

Stem Cell Biology to Regenerative Medicine
BMSC 7810 Sec. 005 2 units
Course Director: Dr. I. Kogut
Students will be introduced to the concept of stem cells with an emphasis on embryonic, pluripotent, and tissue stem cells. Besides their role in normal development of different organ systems, we will specifically address the use of stem cells in tissue engineering and disease modeling. We will then discuss new approaches using stem cells in regenerative medicine. Lastly, we will discuss ethical issues regarding the use of these cells (e.g. the creation of human/animal chimeras for research purposes).

Introduction to Animal Models and Experiments in Developmental Biology
BMSC 7810 Sec. 009 2 units
Course Directors: Drs. L. Barlow, A. Burger
Introduction to animal models in developmental biology: This course offers a hands-on approach to the study of developmental biology including an opportunity to perform experiments on model

systems used in the study of development. In addition, general principles and definitions used in developmental processes will be discussed as well as a focus on specific processes such as gastrulation and neurulation. This knowledge can be directly applied to the study of stem cells and cell biology.

Research in CSDV (Lab Rotations**)**
CSDV 7650 (001 & 002) 1 unit each
(Register for both sections 001 and 002)
Coordinated by the GAC Chair, Dr. Jim Bridges
Students will perform research in the laboratory of one of the members of the program. The rotation will be followed by an oral presentation.

Cell Biology, Stem Cells & Development Seminar
No registration required 0 units
Course Director: Seminar Committee
Seminar series designed to present recent important findings in cell and developmental biology research. Different topics are presented weekly by CSD Training Program faculty, students and visiting faculty. **Attendance is required**. Individual seminar details will be sent by the Program Administrator; additionally, upcoming seminar details are available on the program's website.

Spring Semester - Required Registration

Stem Cells and Development: An Integrated Approach
CSDV 7605 4 units*
Course Directors: Drs. Eszter Vladar, Stephen Santoro, & Ron Vagnozzi
This course aims to familiarize students with fundamental principles in cell, developmental, and stem cell biology. Students will critically evaluate important scientific concepts and develop compelling new hypotheses through in class discussions, 'thought question' exercises and presentations. Finally, students will gain important grant writing and critiquing skills through instruction, practice, and peer evaluation. Completion of the course should facilitate successful pursuit of basic and translational research.
**There is a version of this course that is offered at 3 credits, for students in other programs who do not participate in the writing portion of this class. CSD students are required to enroll in 4 credits of this course and complete the writing portion*.

Critical Analysis of Research in Cell Biology, Stem Cells and Development
CSDV 7606 3 units
Course Director: Dr. Christian Mosimann
First-year students will learn to critically evaluate the scientific literature in preparation for conducting original research in their thesis labs and writing and critiquing research grant proposals. Primary literature will focus on cell and developmental biology topics related to CSDV 7605. The course consists of four blocks, each includes a lecture and 3 paper discussions. Each block session concludes with written mini-proposals and peer critiques.

Research in CSDV (Lab Rotation)
CSDV 7650 (section 001) 1 unit (for 3rd lab rotation)

Coordinated by the GAC Chair, Dr. Jim Bridges
Students will perform research in the laboratory of one of the members of the program. The rotation will be followed by an oral presentation.

Cell Biology, Stem Cells & Development Seminar
No registration required 0 units
Course Director: Seminar Committee
Seminar series designed to present recent important findings in cell and developmental biology research. Different topics are presented weekly by CSD Training Program faculty, students and visiting faculty. **Attendance is required**. Individual seminar details will be sent by the Program Administrator; additionally, upcoming seminar details are available on the program's website.

Summer Semester

Research in CSDV
CSDV 8990 1 unit
All students must be registered during the summer months to be maintain full-time status

B. LABORATORY ROTATIONS IN THE FIRST YEAR.
Rotations serve several important purposes. First, they enable the student to explore and compare several areas of cell and developmental biology research and aid in the choice of a mentor and project for thesis work. Second, rotation seminars provide intense training in the craft and art of public presentation, an essential aspect of future career success. Third, they allow program faculty to evaluate the motivation and intellectual preparedness of students to undertake independent research

ROTATION SCHEDULE FOR 2024-2025:

Fall 1st Rotation: August 26, 2024 - November 15, 2024

Fall 2nd Rotation: November 18, 2024 - February 21, 2025

Spring 3rd Rotation: February 24, 2024 – May 16, 2025

Number of Rotations.
Students must perform 3 rotations before the start of their second year. Students should start their first rotation in the fall semester. Students must complete 3 rotations in 3 separate laboratories in order to advance to their second year. Register for the first 2 rotations (Sections 1 & 2) in the fall; register for your 3rd rotation (Section 3) in the spring. Medical Scientist Training Program (MSTP) students must complete two rotations (during the summers of the first and second year of Medical School. Under exceptional circumstances and at the discretion of the GAC, a student may be allowed to perform an additional rotation during the summer following the first academic year, for the express purpose of enhancing the mentor selection process. CSD will make every effort to assist a student in finding a suitable thesis advisor.

Identifying Rotation Mentors
CSD seeks to maintain a training environment that is supportive, rigorous and aligned with the mission of the program. All CSD training faculty are eligible to serve as rotation mentors; however,

opportunities in each lab may be limited by space, funds, etc. Students should discuss their interests with several potential faculty mentors, several weeks or more before the start of the rotation.

The program strongly discourages rotations with mentors who are not training faculty in CSD. Such rotations will only be allowed if the faculty member has already applied to become training faculty in CSD, and the rotation is approved by the GAC chair and the Program Director.

Rotation Expectations.

For professionals in training, it is not appropriate to require a minimum number of hours for rotation work. Strong self-motivation is an absolutely essential characteristic for an independent scientist, and we expect our students to demonstrate this quality throughout their training. In this regard, students should expect to be in the lab beyond the normal working hours, i.e. evenings, weekends, and possibly over vacation days during the term. This commitment of time is especially important when long, complex experiments are being done. A major part of the mentor's rotational assessment (as well as their willingness to accept a student) will be based on the degree and quality of lab effort. Students should always discuss time off and/or vacation days with their lab mentor in advance, both in their lab rotations and once they enter a thesis lab.

A short, written evaluation of the student's rotation will be provided by the faculty mentor. Students are required to give an oral presentation of their rotation progress. After completing the requirements, rotation grades will be assigned by the first-year advisor in consultation with the rotation mentor and discussed with the student.

Rotation Seminar.

At the end of each rotation the student will present a seminar. The purpose of the seminar is to provide intense training in the craft and art of public presentation, an essential aspect of future career success. Each seminar should be approximately 15 minutes in length (12 minute talk + 3 minutes for questions). The student must rehearse the seminar with their rotation mentor prior to the public presentation. The seminar is an essential component of the research rotation. Students are expected to present a well-organized, clear, and thoughtful seminar. Students should consider the following elements when designing their presentation (although the order need not be strictly followed):

Introduction - a short statement of the question or problem addressed by the rotation, and the hypothesis to be tested.

Background - describe the significance of the question in broad terms for a diverse audience. Describe previous work and its relationship to the project.

Specific experimental aims - what were the particular experimental goals proposed to test the hypothesis?

Methods and Design - explain briefly any unusual strategies or techniques employed.

Results – negative and positive results should be reported

Conclusions and future directions – what can you conclude from your results, and what would you pursue if you remained on the project?

Suggestions for Effective Seminars

1. Avoid reading or memorizing your presentation "word-for-word". Wooden, canned deliveries are dull and very hard for audiences to follow.
2. Prepare and use simple, effective visual aids. Remember that effective communication of data and ideas is your goal! Do not spend undue effort and expense on fancy multicolored slides (especially for text), if color is not required to simplify complex data or concepts. Colored visuals tend to require a darkened room and are often much harder to read than black on white line drawings or letters. Keep text very brief and do not read directly from the screen (audiences are much faster at reading silently!).
3. Use the marker board when appropriate. Diagramming or outlining while you are talking is a highly effective means of explaining concepts difficult to describe with the spoken word. Use of the marker board can also help answer spontaneous questions from the audience.
4. Consider audience questions carefully! Both faculty and students are encouraged to ask questions during and after rotation seminars. A few of these questions may be intended to probe your understanding of your research rather than illuminate an area of confusion. Part of your evaluation will concern your effectiveness in responding to questions. Thus, make sure that you understand the question before answering. Repeat the question or ask for a rephrasing if you need to. Second, relax and take a moment of silence if you must before answering to formulate a coherent answer. Third, if after contemplation you don't know the answer, don't be afraid to say so. We all get stumped from time to time!

For more guidance on effective seminars, students are strongly encouraged to attend a workshop on "How to Give a Scientific Talk" which will be run by Dr. Jeff Moore during the Fall semester.

C. Transfer to the Thesis Lab at End of First Year

An important aim of the rotations is to enable the student to obtain a thesis mentor. After the completion of the three rotations for regular graduate students or two rotations for MSTPs, the student must come to a mutual agreement with a faculty member to act as their thesis mentor. The chair of the GAC and the Program Administrator must be notified on the choice of mentor **on or before June 1st** of the first year. Official transfer to the thesis lab takes place on July 1st. Under exceptional circumstances and at the discretion of the GAC, a student may be allowed to perform an additional rotation during the summer following the first academic year, for the express purpose of enhancing the mentor selection process.

D. Preliminary Exam at the End of the First Year

1. The general format of a preliminary examination for the Cell Biology, Stem Cells and Development Graduate Program is a written grant proposal followed by an oral examination by a preliminary examination committee.

2. The preliminary examination committee will consist of five faculty members. Every year, following the first 2 years after initiation of this preliminary exam format, two committee members will be replaced with new faculty. Each member will serve a minimum of two consecutive years. The committee will also consist of faculty representing different aspects of the research within CSD, such as Development, Cell Biology and Stem Cell Biology.

3. Four weeks before the oral examination, students will be provided with five research topics; one topic from each committee member. Each topic will be represented by 2-3 papers that have been selected by the committee members. Each student will need to pick one topic for their proposal. While students can select the same topic, obviously, students are not allowed to work together on their proposals. The topic cannot have a significant overlap with student's research interests in their future lab and will have to be approved by the committee.

4. Each student will have one committee member assigned as a preliminary examination mentor. The same committee member will also serve as a chair during examination of this student. The main role of the mentor will be to serve as a "go to" person for the student if they (the student) has questions regarding the written and oral portions of the examination. The mentor can advise the student regarding the expectations of the written and oral examinations. The mentor cannot, however, be directly involved in editing or re-writing the student's grant proposal. Mentor also cannot be directly involved in suggesting/designing the experiments or interpretations of potential outcomes that will be described in the proposal.

5. Students will complete the written proposal and deliver it to the prelim exam committee chair by the specified deadline, before the oral examination. This deadline is firm. The proposal is to follow the NIH pre-doctoral fellowship format and can be no longer than 7 pages (1 Specific Aims page plus a 6 page research plan; excluding references).

6. In addition to the written proposal, the student will be examined orally by the committee. The examination for each student will last approximately one hour, unless the committee decides additional time is needed.

7. Students will be evaluated based on the preliminary exam rubric; see Appendix 1. The exam is designed to test each student's understanding of key concepts and ability to think through experimental design, both of which are important for research in biomedical sciences, with a focus on development, cell biology and stem cell biology. While the main focus of the questions will be related to the written proposal, students should expect questions outside the immediate scope of written proposal. All questions, however, will be limited to the material that the student was exposed to during courses and rotations that they had within the first year of a graduate program.

8. After each exam, the exam committee will deliberate and come to a consensus score in each of the 4 areas described in the rubric. Those scores, along with any comments, with be provided to each student at the end of the exam day.

9. If a student scores a 1 in any area of the rubric, that will trigger a need for remediation in that area. If a remediation is needed, it will be individually tailored to that area and each student's needs. Regardless of how the remediation is structured, it must be completed within one month of being assigned. **The students performing a Preliminary Exam Remediation are not allowed any outside assistance. The work must be entirely their own.** However, student questions will be answered by the preliminary exam committee faculty.

10. If a student fails to increase their scores through the remediation, and still scores a 1 in any area of the rubric, this is considered a failed exam. The student will be dismissed from the program.

CSD Preliminary Exam Guidelines (*developed by CSD GAC, October 27, 2020*)

All CSD students will complete the Preliminary Exam at the end of their first year of coursework. This exam typically takes place in the third week of June. Four weeks before the exam, students will be provided research topics from each of the Preliminary Exam Committee faculty members. This committee typically has five faculty members and will thus provide five topics that students can choose from for their Preliminary Exams. Each member will provide 2-3 scientific papers as guidance for completing the Preliminary Exam on their topic.

Each student will choose one of the five topics for their Preliminary Exam. A student may not choose the topic of a faculty member for whose lab they anticipate joining. Students should avoid picking a topic given by any faculty member that they rotated with as well. The Preliminary Exam consists of a NIH F31-style grant proposal followed by an oral defense of their written document. The written proposal is due one week prior to the oral exam date – this is a firm deadline and extensions will not be provided. The proposal will follow the standard F31 format: one page for the Specific Aims and up to six pages for the Research Strategy.

Before the written portion of the exam is submitted, students ***may not*** receive help from their advisor, non-exam committee faculty members, postdocs, or more senior students. The first-year students may discuss topics and ideas amongst themselves but *must* write proposals on their own. Students are allowed and encouraged to reach out to any of the exam committee faculty members, *preferably the one whose topic the student is pursuing*, with questions about their proposals. This helps to ensure that the proper level of assistance is given to each student.

Only after submitting their proposals to the exam committee, students may send their proposals to other students from whom they would like to get feedback. Additionally, students are **strongly encouraged to host and participate in a Mock Oral Exam** with the more experienced students in the program. This event provides an excellent opportunity to get helpful tips from more senior students and to practice answering questions related to their written proposals.

If a Preliminary Exam Remediation is needed, it will be individually tailored to each student's needs. Regardless of how the remediation is structured, it must be completed within one month of being assigned. The students performing a Preliminary Exam Remediation ***are not*** allowed any outside assistance. *The work must be entirely their own*. However, student questions will be answered by the preliminary exam committee faculty.

D. Applying for the Genetics of Development, Disease and Regeneration (GDDR) T32 Training Program

CSD students entering their 2nd or 3rd year of training are encouraged to apply for the GDDR T32 training program. The application period will open in July of each year and selections will be announced by the end of August. For more information on program eligibility and selection process, please refer to Appendix 2.

2nd Year Students

COURSEWORK, PRE-THESIS RESEARCH AND THE COMPREHENSIVE EXAMINATION

A. COURSES

Fall and Spring Semesters – Required Registration
The fall and the spring semesters must each total at least 5 units. Students who are considering enrolling in more than 5 credit hours in either of these semesters should first discuss their enrollment with their faculty advisor, as the faculty advisor will be responsible for the additional expenses incurred. Once you have approval from your faculty mentor to take more than 5 credits, forward the email approval to the Program Administrator.

Research in CSDV
CSDV 7650 (Section 0V1) 1-5 unit*
Course Director: Dr. Jeff Moore
Laboratory research with CSD Training Program faculty.

Responsible Conduct of Research
BMSC 7811 1 unit
Course Director:
All rising 2nd year students are required to enroll in 1 unit of BMSC 7811 and will be expected to enroll again every 4 years

CSD: Advanced Topics Discussion (Journal Club)
CSDV7000 1 unit
Course Directors: Mike Lippincott and Charles Griffin
The Student Journal Club is developed and run by CSD students. This course provides opportunities to learn outside your thesis topic, sharpen presentation skills, and socialize with CSD students. The Journal Club is a year-long course, running through both the Fall and Spring semesters; students will not be allowed to stop participation at the end of the Fall semester or begin participation in the Spring semester. Students are expected to attend class meetings during both semesters; however, they should only enroll in CSDV7000 for the Spring semester. Intent to participate must be stated at the **mandatory** Journal Club Town Hall held before the first session of the Fall semester (August 30th at 3pm).

All CSD students are required to complete a course in statistics by the end of the fourth year. Two options exist to meet this requirement (see below). MOLB7950 and BMSC7820 are both offered in the fall semester. CSD students are strongly encouraged to take either of these courses during their second year, and review the course syllabi with their mentors to identify the course that better aligns with their training plans. Students who have already completed a similar course or have identified a different course they would like to take may request an exemption from the Program Director. If the exemption is granted, the student must forward that confirmation to the Program Administrator.

Informatics and Statistics for Molecular Biology

MOLB 7950 3 units

Course director: Jay Hesselberth

This course teaches students to design and analyze experiments commonly used in molecular biology. The course is organized around the Central Dogma (DNA > RNA > Protein) wherein each block presents 2-3 experimental approaches. Each week, a new experiment is introduced with a discussion of appropriate design and statistical considerations. The remaining weeks' classes are devoted to digging into the analysis of a sample data set with hands-on programming.

Statistics and Data Analyses for the Biomedical Sciences

BMSC7820 3 units

Course Director: Ethan Lange

This is a basic introductory level course in applied biostatistics designed for students pursuing graduate degrees in biomedical research that is designed to meet minimum requirements for a biostatistics/statistics course.

NOTE:	Each fall semester, all students enrolled in at least one credit are automatically enrolled in the university's student health insurance plan. You may opt out if you provide proof of your own insurance, but you must do so by the Student Health Office's deadline. Contact the Student Health Office, studentinsurance@cu.edu with questions.

Summer Semester – Required Registration

Doctoral Thesis

CSDV 8990 1 unit

All students must be registered during the summer months to be maintain full-time status

B. Update Talks

Beginning in the second year, each student is required to give an annual update presentation to the program. The first update should be before May 31 of the 2nd year, and is scheduled prior to or at the beginning of the academic year. The Program administrator will reach out to you to schedule your presentation. We also recommend that you form a committee and have one pre-comprehensive exam meeting at the time of your first update seminar. To schedule a committee meeting, you will need to be sure all your members can attend, and coordinating faculty schedules can be challenging. Again, we want to emphasize that arranging this update is your responsibility, and urge you to make plans with your committee.

C. Comprehensive Exam

At the beginning of the second year of study CSD graduate students will begin preparing for the Comprehensive Exam. It is highly recommended that the student carefully read the Graduate School Policies & Procedures guide on Comprehensive Examination policies and deadlines, and check the instructions and forms from the Graduate School website well ahead of the planned

examination so all required paperwork can be completed on time. Completed paperwork must be submitted to the Program Administrator no later than one month prior to the examination date: (https://graduateschool.cuanschutz.edu/forms-resources/resources).

Note: A student must be registered at the time they take the Comprehensive Examination.

Application to the Graduate School for Admission to Candidacy

Applications must be completed no later than one month before the exam. The *Application for Candidacy* form and the *Exam Request* form are available from the Graduate School and must be approved by the Program Director and returned to the Program Administrator. The date of the Comprehensive examination and the composition of the committee must be registered with the Graduate School. The student must have completed a minimum of 30 didactic credit hours to be eligible to schedule the exam; Pass/Fail classes and CSDV 8990 credits do not count toward the 30 hour minimum. Coursework taken in the semester in which the exam takes place counts towards the 30 hour minimum.

Students must take the Comprehensive Examination for admission to candidacy for the CSD Ph.D. **between June 1st of their second year and December 31st of the third year**. Any deviation to this requirement must have approval from the PI, Graduate Advisory Committee, and the Program Director. The Comprehensive Examination Committee shall consist of a minimum of five Graduate Faculty members. At least one of the members must be outside the Program's core training faculty. The thesis advisor may not serve as a member of the Comprehensive Exam Committee. The majority of the members, including the chair, must be from the training faculty of the CSD Program. Students should contact members of the Graduate Faculty whom they wish to be on their committee, in consultation with the Director of the Program and their thesis advisor. Students should inform the committee members of their background, the topic of their thesis research and their preliminary results. In addition, the student arranges the time and location of the exam, and informs the members of the committee that the examination requires three hours. The student should provide the names of the committee members to the GAC, and also submit to the Program Administrator; additional paperwork may be required for outside committee members.

The examination will have as its focus a thesis research proposal written by the student using the format of a NIH pre-doctoral fellowship. Although preliminary data collected by the student are helpful, it is not essential for the proposal. The written proposal must be distributed to the Comprehensive Exam Committee **at least two weeks prior** to the examination. The student must adequately demonstrate the scientific knowledge and ability to defend this proposal, as well as satisfying the overall requirements for the examination as set forth by the CU AMC Graduate School Policies & Procedures guide. The examination will consist of a 30-minute seminar by the student, with 10 minutes of general questions from the audience, and then detailed questions from the Thesis Committee. As stated in this Graduate School guide, the comprehensive examination "will test your mastery of a broad field of knowledge, not merely the formal course work completed." *Students are strongly encouraged to consult with their committee members prior to the exam to discuss the plans for the exam and subject areas each member expects the student to have mastered*.

Comprehensive Exam Goals

- The exam process is intended to help students advance their scientific and communication skills. Think journey rather than destination.
- The exam process is meant to help students focus their thesis work, increase their knowledge of CSD topics, and improve their productivity in the lab. The exam is not meant to be punitive.
- Another goal of the exam is to prepare students for future scenarios that require public speaking and "chalk talk" style defense of their data and ideas.

Comprehensive Exam Guidelines:

1. The exam should be completed by December 31st of the student's third year in the program.

2. The written exam follows the formatting guidelines of a F31 NRSA application:

Title	
Short Introduction and Specific Aims	1.0 page
Research Strategy	6.0 pages
Significance and Background	
Any preliminary data	
Experimental Design & Methods	
Expected Results & Interpretation	
Alternative approaches	
Total	7.0 pages

Literature citations are additional to the 7 pages. Full references with titles are required.

The written proposal **must** be given to all members of the committee **at least two weeks before** the comprehensive exam.

3. The public seminar should be 25-30 minutes with questions. The talk will be open to the university community. After the talk, questions from those in attendance will be requested. After the questions have been addressed, all but the graduate faculty on the Comprehensive Examination Committee will be requested to leave.

4. Examiners will be provided with the student's preliminary exam results to determine training progression. Examiners should ask questions that evaluate the criteria present in the four-area scoring rubric (see Appendix 3). The exam chairperson is responsible for keeping the questioning focused.

5. Examiners should consider the stage of the student when scoring. A "4" is a strong performance score for the level, not a perfect one.

6. A passing exam will have scores of 3 or 4 in each area. The exam score in each area is based on the collective consensus opinion of the examining committee. Thus, only one report will be generated with a single score in each area.

7. A score of 1 or 2 in any area requires remediation. This does not indicate a failed exam. Instead, additional conditions need to be met to satisfy the exam requirements. This involves completing

a remediation plan (below). The intent of remediation is to improve the student's skills and knowledge. It is not meant to be punitive.

8. Remediation plans will be given to the student in writing. Remediation plans should be focused, completable in ≤ 6 weeks, and be designed to specifically improve the area(s) of deficiency. A revised rubric will then be completed to reflect the outcome of the remediation.

9. If remediation is unsuccessful, the exam is then considered a "fail".

10. The completed comprehensive exam rubric, including the scores and comments, will be uploaded to the student's permanent record by the exam chairperson. In the case of a remediation, the remediation plan and both the original and revised rubrics will be uploaded to the record.

11. The mentor acts as an observer during the exam. They do not provide or determine scoring. The mentor is permitted to answer questions from the examining committee about the student's aptitude and performance in the lab.

Possible Results
Pass (no conditions)
Conditional Pass (conditions must be detailed)
Fail (the student must leave the graduate program)

NOTE:	After passing the comprehensive exam, all PhD students are required to register for Doctoral Thesis CSDV 8990 (instead of CSDV 7650 section 0V1) each fall and each spring. Failure to do so can result in the student being required to retake the comprehensive exam. A student may register for up to 10 units of CSDV 8990 in the semesters before and the semester in which the comprehensive exam is taken and passed.

D. APPLYING FOR FELLOWSHIPS

All students are encouraged to apply for fellowship support from outside agencies, e.g. NIH, NSF, Howard Hughes Medical Institute, March of Dimes, American Heart Association, etc. Many students work with their mentor to edit their comprehensive exam proposal, which utilizes a NIH F31 NRSA predoctoral fellowship format, for submission to external funding agencies. Students can prepare and submit a fellowship application prior to the comprehensive exam and are encouraged to do so. If students submit a predoctoral fellowship prior to the comprehensive exam, students can adapt a submitted fellowship application for use in the comprehensive exam written document. The plan to adapt the fellowship in this way must be communicated to the exam committee **at least one month before** the comprehensive exam.

A. COURSES

Fall and Spring Semesters – Required Registration
The fall and the spring semesters must each total at least 5 units. Students who are considering enrolling in more than 5 credit hours in either of these semesters should first discuss their enrollment with their faculty advisor, as the faculty advisor will be responsible for the additional expenses incurred. Once you have approval from your faculty mentor to take more than 5 credits, forward the email approval to the Program Administrator.

NOTE: Comprehensive exam (see p. 14) must be taken by December of Year 03. Students must have 30 didactic credits to be eligible to schedule their Comprehensive exam. All graduate level courses (5000 level or above) count towards Comps eligibility except Pass/Fail courses (such as CSDV7000) and CSDV 8990. Note that courses taken in the exam semester do count towards Comps eligibility.

Elective or Advanced Topics Course
Students are required to take at least one elective or advance topics course each year during years 3-5. Options include CSDV7000, CSDV7100, MOLB7950/BMSC7820, and courses listed on p. 29-31. If a student would like to satisfy this requirement by taking another course, which is not listed on p. 29-31, they must receive approval from the Program Director and the Chair of the Curriculum Committee.

CSD: Advanced Topics Discussion (Journal Club)
CSDV7000 1 unit
Course Directors: Mike Lippincott and Charles Griffin
The Student Journal Club is developed and run by CSD students. This course provides opportunities to learn outside your thesis topic, sharpen presentation skills, and socialize with CSD students. The Journal Club is a year-long course, running through both the Fall and Spring semesters; students will not be allowed to stop participation at the end of the Fall semester or begin participation in the Spring semester. Students are expected to attend class meetings during both semesters; however, they should only enroll in CSDV7000 for the Spring semester. Intent to participate must be stated at the **mandatory** Journal Club Town Hall held before the first session of the Fall semester (August 30th at 3pm).

Advanced Writing Workshop
CSDV7100 1 unit
Course Directors: Tina Piarowski and Ian Purvis
This course is a student-led writing workshop focusing on developing writing skills through the submission, editing and discussion of drafts. Draft types will be chosen by the students enrolled and will include manuscripts, theses, and documents related to career development. Only post-comps students may enroll in CSDV7100.

Doctoral Thesis
CSDV 8990 1 – 5 units*
Students will generate an original body of research that constitutes a significant contribution to the field of cell and developmental biology. Suitability of thesis research is judged by the Thesis Committee. Students write a PhD thesis and defend the document at an oral examination.

NOTE:	Each fall semester, all students enrolled in at least one credit are automatically enrolled in the university's student health insurance plan. You may opt out if you provide proof of your own insurance, but you must do so by the Student Health Office's deadline. Contact the Student Health Office, studentinsurance@cu.edu with questions.

Summer Semester – Required Registration

Doctoral Thesis
CSDV 8990 1 unit
All students must be registered during the summer months to be maintain full-time status.

Continuous Registration Requirement.
Students must register continuously following successful completion of the comprehensive examination, i.e., 5 credits for fall and spring semester and 1 hour of thesis research (CSDV 8990) during the summer. All students must register for both the fall and spring semesters. It is the student's responsibility to register for the correct courses in a timely manner – all late fees and finance charges will be the responsibility of the student.

B. Update Talks

Third year students will not be required to give an update talk in the same academic year that they take their comprehensive exam.

Students in their 4th year and beyond are required to give an annual update presentation to the program. Update talks are scheduled prior to or at the beginning of the academic year. The Program administrator will reach out to you to schedule your presentation. Again, we want to emphasize that arranging this update is your responsibility, and urge you to make plans with your committee, and schedule your presentation with the program administrator well in advance.

C. Thesis Committee Meetings

Students are required to meet at least once each year with the thesis committee although more frequent meetings can be scheduled at the discretion of the student or thesis committee. The candidate should provide the program with a 20-30 minute talk as well as a brief written summary of the progress made on the stated aims given to the committee at least one week prior to the meeting. A template for the progress report is provided in Appendix 4 of this handbook. Following

the meeting, the committee chair is required to submit a Thesis Meeting Assessment in Gaia that includes the following:

- Date of the meeting.
- Committee composition.
- Numerical rating (scale of 1-3) of student's performance in areas of research progress, evaluation of literature, program concepts, conducting research and oral communication.
- Description of accomplishments since the previous meeting.
- Description of any concerns from the committee.
- Recommended goals to be accomplished by the student for the next meeting.

Ph.D. Thesis

After passing the Comprehensive Examination, the student enters Ph.D. candidacy. During the following years the students perform research towards a thesis defense. Students must give annual reports on the progress of their thesis research to the CSD faculty in the form of 30-minute seminars, and meet at least annually with their Thesis Committee. The Chair of the Thesis Committee will submit a report of the meeting and any resulting recommendations using the online evaluation system provided by the Graduate School (https://gs.ucdenver.edu/gaia/splash.php).

Upon completion of a body of original research that constitutes a significant contribution of new knowledge to the field of cell, developmental or stem cell biology, students will write a Ph.D. thesis containing this information, and defend this document at an oral examination scheduled by the Graduate School. Check with the Graduate School for current deadlines, thesis format requirements and required paperwork prior to writing the thesis and scheduling the defense.

1. Guidelines

All doctoral students are required to submit a thesis (or dissertation) to the Graduate School as partial fulfillment of the requirements of the degree of Doctor of Philosophy. The form and scope of this thesis is determined by the student, the thesis advisor, the Advisory Committee, and the Program. The thesis should be based upon original investigation and showing mature scholarship and critical judgment as well as familiarity with tools and methods of research. It must be essentially approved by the examining committee before the final examination can be taken.
The Graduate Program in Cell Biology, Stem Cells and Development amplifies the definition of the thesis as follows:

> The successful thesis presents a problem-orientated, original and substantive investigation. The methodology and results contained in the thesis must be conclusive and of quality. The standards are to be those maintained by quality, peer-reviewed scientific journals. It is the expectation of the program that the student have 1 or more first author publications submitted prior to the thesis defense.

2. Thesis Committee

Once a student is admitted to candidacy, they should establish a Thesis Committee with the advice of the thesis advisor and the Director of the Graduate Program. The committee need not be the same as the Comprehensive Exam Committee but should be composed of five Graduate Faculty members; at least one member must be outside the program and the majority from within the program. The thesis advisor is a voting member of this committee. One faculty member of the program should be selected to serve as a chair of the Thesis Committee. This committee can be the same as the Comprehensive Exam Committee.

Please review the ORE Policy on Conflict of Interest and Undue Influence for Thesis Committees here: https://medschool.cuanschutz.edu/ore/forms-and-resources

3. Graduate Advisor

The Chair of the Thesis Committee serves as the advisor to the student and will monitor their progress. The Chair must be a member of the Program. It cannot be emphasized enough, however, that each student is responsible for their own progress.

4. Guidelines for Supervision of Thesis Work

1. Because all students present their work each year, all Graduate Faculty should follow the progress of all students. When concerns arise they should be discussed immediately with the student, the Thesis Advisor and/or the student's Thesis Committee.

2. Students are encouraged to meet every six months, but must meet at least once a year, with their Thesis Committees. Students must submit a written update on their progress to the Committee at least one week before the Committee meeting (see template in Appendix 1). Students are encouraged to schedule their committee meeting soon after their yearly update talk. The Chair of the Committee will file an evaluation and summary of the meeting and recommendations of the thesis Committee using the online student assessment portal provided by the Graduate School. The meetings should be documented (date of meeting, items discussed, committee recommendations, list of attendees, signatures of the student and committee chairperson) and a copy provided to the Program Administrator for inclusion into the student's file. The Thesis Committee can recommend more frequent meetings when the members feel more careful monitoring is warranted.

3. When the student and their thesis advisor agree the work for the thesis has been completed, the student must meet with the Thesis Committee and receive formal approval to begin writing the thesis.

5. Preparation of Thesis and Thesis Defense

1. Watch the Graduate School's instructional video on how to format your thesis.

2. The Thesis Committee must formally approve the written thesis before the final examination can be taken. Written PhD thesis approval from the chair of the Thesis Committee is required prior to scheduling of the thesis defense with the Graduate School. The Thesis Approval Form may be obtained from the program administrator. Furthermore, the thesis advisor must find the thesis acceptable prior to submission to the rest of the committee. It is inexcusable for everyone concerned if the student reaches the point of their PhD thesis defense and encounters major difficulties with the thesis.

3. In addition to completing the thesis document, prior to the defense of the thesis, each CSD student must submit a minimum of one original research manuscript for publication in order to receive the PhD. The paper must be first-authored by the student, and represent a component of the student's overall thesis work. Second or middle authorship or authorship of a review article or chapter does not meet this requirement.

4. Arrangements for the thesis defense must be made with the Graduate School office at least one month in advance. Check the Graduate School's "Defense and Graduation Deadlines" form for relevant deadlines for paperwork submission, dissertation defense, and more. The student must be registered for a minimum of 5 credits of CSDV 8990 at the time of the thesis defense (including during a summer semester). In addition, a copy of the thesis must be given to the Thesis Committee **at least two weeks** before the defense, and this copy must be signed by the student's faculty mentor indicating the mentor's approval of the document.

5. The thesis defense is the final examination of the thesis and related topics. It includes an oral examination of the salient points of the research, its conclusions and its integration with the rest of the field. The oral examination will be conducted by the Thesis Committee and only members of the Graduate Faculty may be present. The final decision regarding the result of the thesis defense is made by the Committee.

6. All corrections to the written thesis required by the Thesis Committee must be completed within thirty days from the date of the thesis defense. The signed, written document must be submitted to the Graduate School at that time.

7. The student must receive affirmative votes from the majority of the committee. The examination may be attempted only once. Disqualification of the thesis examination results in dismissal from the Graduate Program without a degree.

IV. Graduate School standards and ORE Policies

All ORE policies are available here: https://medschool.cuanschutz.edu/ore/forms-and-resources

A. Credits. The Graduate School requires at least 30 semester hours in course work (rotations and Research CSDV 7650 count as course hours) and 30 semester hours of thesis research (CSDV 8990) for the PhD. All work undertaken as a graduate student must be in compliance with the academic Code of Honor (see the Graduate School's website).

B. Maintenance of a 3.0 GPA. All students must maintain an average of "B" or better in their course work. Students are expected to earn a "B" 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 GAC. Required courses completed with a grade of below "B-" cannot be counted towards PhD requirements.

C. Preliminary exam. In order to continue in the program, a student must pass the Preliminary Exam at the end of the first year. If the Preliminary exam is failed, the student will be asked to retake part of the exam (i.e., remediation; see p. 11, point 9). If the student fails the retake, they will be asked to leave the PhD training program.

D. Remedial and Disciplinary Actions. Students whose cumulative GPA falls below 3.0 will be placed on Academic Probation by the Graduate School. The student must earn a GPA of 3.0 in each of their next two semesters in order to be removed from Academic Probation. The Graduate School requires that after a student is put on academic probation, they must maintain a 3.0 in all subsequent semesters. Failing to meet either condition will lead to immediate dismissal from the Graduate School. A "B-" or below in any required course is considered unsatisfactory academic progress and more than one "B-" or below is grounds for immediate dismissal from the Program.

A graduate student who receives an unsatisfactory grade in a course (a B- or below) may repeat that course once or successfully complete an alternative assignment, upon written recommendation from the GAC and approval by the Graduate School Dean (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.

After two semesters, a GAC meeting will be held to determine the student's progress. If the student's cumulative GPA is 3.0 or above, the student will be removed from probation. If the student's cumulative GPA is below 3.0, the chair of the Thesis Committee, the thesis advisor and the student will meet with the CSD Steering Committee. The Steering Committee will make one of the following determinations:

1. The student is not in good academic standing and will be placed on probation again for not more than 30 days.
2. The student is not in good academic standing and will be released from the program.

All meetings will be thoroughly documented and given to the Program Administrator for placement into the student's file.

E. Change in Thesis Lab. If a student leaves a thesis lab for any reason, (but is still considered by the CSD GAC to be in good academic standing) the student has 1 current semester (but no more than 90 days) to relocate to another thesis lab and determine a new thesis advisor if necessary. It is the student's responsibility to locate another thesis lab and/or advisor. Within those 90 days, the student must rotate for a minimum of 6 weeks in a potential new advisor's lab, so that the final decision to join the new lab can be made within the 1 semester/90 day window.

F. Time Limit of PhD Studies. Students have eight years from the time they enter Graduate School to complete all requirements for the degree. Continuation after eight years requires the approval of the student's Thesis Committee, the CSD Steering Committee & the Graduate School.

G. Personal Leave of Absence. Personal LOAs are approved by a student's Program in consultation with ORE the Assistant Dean of Students Affairs (Andy Bradford). A student considering an LOA should first speak with their thesis advisor (if applicable) and Program Director or Program Student advisor. Students should also meet with the ORE Assistant Dean of Student Affairs (Andy Bradford). It is important that students are advised of all their options and directed to appropriate support.

H. Medical Leave of Absence. The Office of Research Education (ORE) encourages and recommends Graduate students considering an MLOA to first speak with their advisor and Program representative and/or meet with the Assistant Dean for Student Affairs (Andy Bradford, andy.bradford@cuanschutz.edu) to discuss options. As the student's health and confidentiality are priorities, students are not required to notify their Programs, and may directly contact the Office of Student Outreach and Support.

I. Faculty member who leaves the institution. The Office of Research Education (ORE) and the School of Medicine (SOM) PhD programs work to ensure that all ORE PhD students have optimal PhD training conditions. Major challenges occur, however, when a student's PhD mentor leaves the institution, and the student has not completed the PhD requirements. Depending on the student's stage in her/his/their research and the program, the challenges will vary. See ORE's policy regarding students whose mentors leave the institution here: https://medschool.cuanschutz.edu/ore/forms-and-resources

J. External Employment for Graduate Students

Graduate students, in good academic standing, may, with appropriate approval, work a maximum of 10 hours per week. Such employment must be approved in advance in writing by the Students Program Director for first year students and by Program Director and Thesis advisor for those students who have entered a laboratory or who transfer or are directly admitted to a laboratory.

The Office of Research Education and the Students advisory/ thesis committee must also be informed of any students approved for external employment. External employment must not conflict with any required elements of a student's PhD training. Examples include but are not limited to: 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.

Approvals must be reviewed and reported by the student's Program and Advisory committee every 6 months. Students will attest that they have not exceeded approved hours.

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 Students 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.

V. Obligations, AI Policy and Record Keeping

A. Attendance. All graduate students are **required** to attend the weekly Cell Biology, Stem Cells and Development (CSD) seminars (usually, but not always, held on Wednesdays at noon) and specialized research forums. These seminars are a mixture of talks by invited speakers and research reports from the faculty, students and postdoctoral fellows in laboratories of the Cell Biology, Stem Cells and Development Program faculty.

All graduate students are **required** to attend post-rotational seminars, comprehensive examinations, student update presentations, and Thesis Defense Seminars given by CSD program students.

All notebooks, original data and reagents from rotational and thesis work are the property of the advisor and must be left with the advisor at the completion of the work.

It is the student's responsibility to register for courses in a timely manner – all late fees and finance charges will be the responsibility of the student.

B. Colorado Residency. First-year students who are domestic students must obtain a Colorado Driver's License at the time of arrival at the University of Colorado School of Medicine to begin the process of establishing Colorado residency. If residency has not been established by the beginning of the second year, the student is responsible for the non-resident portion of tuition that exceeds the resident assessment. The paperwork for establishing Colorado Residency must be filed with the Registrar prior to second year registration. Please check the Registrar's website for full details: https://www.cuanschutz.edu/registrar

C. Guidelines for the Use of AI and Machine Learning Tools in CSD Courses

Advances in generative Artificial Intelligence (AI) language models have created tools with potential to enhance scientific writing, including accelerating the writing process and reducing barriers to non-native English speakers. However, these tools also come with major pitfalls, including falsified or inaccurate information, breaches of confidentiality, and plagiarism issues. Importantly, improper use of AI tools has the potential to undermine the learning objectives of coursework and create inappropriate advantages for some students over others.

This policy establishes a simple set of guidelines for acceptable and unacceptable use of AI language model tools in CSD courses. Our goal is to promote acceptable use of new technology while maintaining our overall goals and standards for training. Failure to follow these guidelines may result in course failure. Any questions regarding this policy and its implementation should be directed to the Course Directors and CSD Program Director.

Acceptable use

1. *Language and grammar checks*. AI tools can be used to check your drafts for grammatical errors. This provides an opportunity for you to learn rules and best grammatical practices.

2. *Identifying articles related to a topic of interest*. AI tools can be used to identify literature related to a particular topic. Consider this a starting point to direct you to new literature. Your job is then to read this literature, evaluate it, synthesize the content, and use that synthesis to develop a rationale for your original ideas and experimental plans.

Be honest and transparent about the use of AI tools in coursework. Citation of any use should be included in the bibliography of your written assignments, and include the name of the specific tool (and version) and how it was used. *Ex: ChatGPT, v4 was used to make evaluate the grammar in this proposal. Suggestions from this evaluation were included in the final draft.*

Unacceptable use

1. *Drafting outlines or paragraphs for research proposals*. Writing assignments in CSD courses are an expression of your original thinking and writing ability. You may not use AI tools to identify proposal topics or to generate potential experiments for the proposal. You may not use AI tools to generate new written content in your proposal. Although AI tools can be used to evaluate the grammar of your own, original written content, and make suggestions to improve grammar and clarity, they cannot be used to generate new sentences for your writing assignments. Verbatim use of sentences generated by AI tools will be considered plagiarism.

2. *Drafting peer review summaries*. You may not use AI tools to generate summaries or reviews of your classmates' work. Peer review is an excellent opportunity to sharpen your critical thinking and evaluate alternative ideas on a topic, and provides a unique opportunity for practicing concise written communication. Use this opportunity to consider the proposal from your peer and provide your own perspective. Using AI tools to generate summaries or reviews denies you this opportunity, and denies your peer from gaining your perspective. Furthermore, uploading content from another individual's proposal to an AI tool may violate confidentiality, as the uploaded content may be disseminated or used for other purposes and without your consent. NIH has recognized this threat and recently adopted a policy that prohibits the use of generative AI technologies for the peer review process.

D. Student's Files. A file for each student will be kept by the Program Administrator. All relevant records should be given to the Program Administrator for the files, including published abstracts and papers, notifications of awards and honors, and copies of forms filed with the Office of Research Education. These files should reflect the total record of the student during their entire graduate career. Upon written request, the records may be examined by the student.

VI. Other CSD Program events

A. Annual Student Research Retreat.

Each fall, the students host an out-of-town retreat for the students and faculty in the Graduate Program in Cell Biology, Stem Cells and Development. The purpose of the retreat is twofold: 1) to provide everyone with the opportunity to get together and interact on a scientific/intellectual level so as to cultivate new interactions and strengthen existing ones; and 2) to provide an opportunity for incoming first year CSD and Biomedical Sciences Program (BSP) graduate students, and 1st and 2nd year MSTP students to become familiar with the research activities and faculty within the CSD Program. The retreat is usually held in October. Current senior students (2nd year and beyond) are expected to present their work either via a poster or a talk.

B. Participation in Recruitment Functions.

During February/March each year, prospective student applicants visit our program for interviews. It is in the Program's best interest to attract and retain the best of these prospective students. To do this we need the help of current students and CSD faculty who can convince these individuals that our Program is the place to be! When asked, please be willing to spend some time with prospective students during dinners or other functions. Our CSD Program can and has flourished with your irreplaceable help.

C. Description of committees.

Each committee within the program has a student representative. Below is a description of the duties for each position:

Recruitment: This committee reviews submitted applications to the graduate program, selects candidates to interview in person or by Zoom, organizes recruitment weekend, and ultimately selects who will be admitted to the program. The student members participate fully in the entire process, and in particular are in charge of enlisting and organizing the student body to help with both academic and social recruitment efforts.

Advising: The Graduate Advisory Committee helps students maintain progress toward their Ph.D. degree. As a member of this committee, the student member helps discuss student progress and may be recruited to and/or advise the committee to tutor first year students in need. This committee requires that the student member be a doctoral candidate, i.e., has passed the Comprehensive Exam.

Curriculum: This committee discusses the current curriculum and suggests and implements changes in the best interest of the program and students, including but not limited to selection of Advanced Topics courses to be offered each academic year based on faculty availability and student interests.

Membership: This committee is responsible for faculty membership within the program. The student member participates in the establishment of guidelines for faculty membership, reviews current faculty participation, and makes recommendations concerning new faculty applicants.

Retreat: Every fall, the program has a retreat (typically overnight) in a mountain location. It is the role of the students (two) on the Retreat Committee to organize the retreat with the oversight of a

CSD graduate program faculty representative. With a pre-determined budget in mind, the students have a role in selecting the location as well as an invited speaker.

Diversity, Equity and Inclusion (DEI) Coordinator: The CSD Program is committed to promoting an inclusive and equitable training environment that embraces diversity, eliminates structural biases from recruitment and training, and supports the identities and values of our students. The DEI Coordinator is a faculty leadership position that focuses support for these efforts, and seeks to develop new education and training activities within CSD that may be shared across CU AMC Ph.D. programs.

Steering Committee: This committee consists of the chairs of each of the program committees plus additional members as deemed appropriate by the director of the program.

Student Executive Committee: Consists of the student members of the Program Committees (Advising, Recruitment, Curriculum, Membership and Retreat) and additional members to represent each cohort in the student group, and is chaired by a student member of the Advising Committee. The goal of this committee is to organize student activities and provide a mechanism to discuss student issues that can be directed to the Steering Committee and/or program director.

D. Advanced Topics and Electives.

Advanced Topics in CSD (e.g. CSDV 7000, 7100, 7670 and 7675, content varies year to year) are special interest courses intended for 2nd year students and beyond. These are 1-2 credits and comprise 15-30 hrs of meeting time within a semester. Students are encouraged to submit ideas for CSDV Advanced Topics Courses to the Curriculum Committee.

Students are required to take at least one elective or advance topics course during years 3-5. Students who are in the program for longer than five years are not required to take an Advanced Topic during the academic year of their defense. This requirement has been in effect since the 1991-92 academic year.

CSD: Advanced Topics Discussion (Journal Club)
CSDV 7000 1 unit

Advanced writing workshop
CSDV 7100 1 unit
Course Director: Dr. Charles Sagerstrom
This course is a student-led writing workshop focusing on developing writing skills through the submission, editing and discussion of drafts. Document types will be chosen by the students enrolled and may include manuscripts, figures, theses, and documents related to career development. Students may only enroll in CSDV7100 after they are post-Comps. GDDR Training Grant trainees are required to take CSDV7100 during their graduate studies.

Developmental Genetics
CSDV7607 2 unit
Course Director: Dr. Bruce Appel
Course participants will read, present and discuss scientific literature addressing topics in developmental, disease, and regenerative genetics. The course will be organized into 4 blocks, with each block focusing on one topic.

Advanced Topics in Cell Biology Stem Cells and Development: Organoids
CSDV 7670 2 units
Course Director: Peter Dempsey
This 2 credit course is an introduction to concepts and practice of organ and tissue modeling using both adult and pluripotent stem cell organoid culture systems combined with bioengineering applications. Lectures/article reviews will be balanced with a significant, hands-on lab component to gain experience in organoid culture techniques. This course is offered in Fall or Spring semester, please contact course directors for information on when the class will be held during the academic year.

Practical teaching experience in Cell Biology, Stem Cells and Development
CSDV 7675 1 unit
Course Director: Julie Siegenthaler
Students will be paired with a CSD faculty mentor to develop a class session for IDPT 7801 courses directed by CSD faculty, CSDV 7605, CSDV 7606 or CSDV 7670 (depending on student interest and faculty availability). Each session will include a practice presentation and post-session critique.

Practical mentoring experience in Cell Biology, Stem Cells and Development
CSDV7676 1 unit
Course Director: Jeff Moore
This course trains PhD students in effective mentoring skills for a research lab setting. Students will receive training in a wide variety of topics including project design, communication, conflict resolution, creating equitable and inclusive mentoring relationships, and more. This course is intended for students who are further along in their training and seeking to build professional skills that will enable them to be successful in the next stage of their career. As such, it is offered for students in year 2 or beyond of their training. GDDR Training Grant trainees are required to take CSDV7676 once, as part of their roles as mentors in the Developing Scholars Program.

Introduction to Microscopy
CSDV7680 1 unit
Course Director: Victor Ruthig
This course will introduce students to the principles of image acquisition, analysis, data management & sharing, and rigor & reproducibility. Microscopy content will be mostly focused on systems available to CSD students. Limited lectures and select readings will prepare students for hands on work using prepared modules in class and group discussions.

Electives offered by other departments/programs.
A few electives are highlighted here, but courses change yearly. The best resource for course offerings will be found on the registrar's website when you register for each upcoming semester. Below we list several frequently offered electives for advanced graduate students. STA=subject to space availability.

BIOE5420 (FALL)	Engineering the Extracellular Matrix Instructor(s): K. Masters
IMMU7530 (FALL)	Introduction to Immunology

Instructor(s): A. Bernard

MOLB7950 (Fall) Practical Computational Biology for Biologists (R)
Instructor(s): M. Taliaferro

NRSC7615 (Fall) Developmental Neurobiology
Instructor(s): C. Doll/ S. Franco

MOLB7800 (SPRING) Advanced Topics in Molecular Biology (STA)
Instructor(s): O. Rissland

MOLB7900 (SPRING) Practical Computational Biology for Biologists (Python)
Instructor(s): S. Ramachandran/M. Taliaferro

PHCL7606 (SPRING) Receptors and Cell Signaling
Instructor(s): M. Dell'Acqua/ M.Caino

PHCL or MOLB7801 (SPRING) Rigor and Reproducibility in Biomedical Research
Instructor(s): M. Breuss

CANB7600 (SPRING) Cancer Biology
Instructor(s): S. Nordeen

Independent Studies in Cell and Developmental Biology (CSDV 7850)
Independent Study is to accommodate students who wish to (1) take a Professional School Course for credit and (2) gain a defined expertise with a faculty mentor other than their thesis advisor. Consent of the faculty member offering the Independent Study and the Program Director are required.

VII. CURRENT STUDENTS AS OF AUGUST 2024

STUDENT	START YEAR	THESIS ADVISOR
Elliott Brooks	2018	Sussel
Kaitlin Alemany	2019	Moore
Amy Briggs	2019	DeGregori
Hannah Moran	2019	Mosimann
Omar Ochoa Olmos	2019	Brzezinski
Samantha Payne Landgrave	2019	Zuscik
Christina Piarowski	2019	Barlow
Ian Purvis	2019	Brzezinski
Maria Hansen	2020	Sussel
Trevor Isner	2020	Barlow
Bryan Johnson	2020	DeGregori
Abigail Mumme-Monheit	2020	Nichols
Sylvia Nunez	2020	Sagerstrom
Christopher Schaaf	2020	Sussel
Wolfgang Schleicher	2020	Pearson
Shane Williams	2020	Dempsey
Yuzhu Cheng	2021	Reis
Erik Collet	2021	Pearson
Devon Conradson	2021	Vagnozzi
Mikaela Follmer	2021	Bates
Sophia Kim	2021	Siegenthaler
Addison Rains	2021	Rissland
Harrison Wells	2021	Mosimann
Kelsey Abrams	2022	Appel
Jeremy Brown	2022	Moore
Michael Lippincott	2022	Way
Jeremy “JP” Martin	2022	Franco
Susannah Schloss	2022	Nelson
Kaleigh Schuler	2022	Clouthier
Amanda Stenzel	2022	Barlow
Amanda Garfield	2023	Mosimann
Charles Griffin	2023	Fantauzzo
Maggie Keating	2023	Nichols
Edwin Ortiz Gaxon	2023	Majka
Preston Stafford	2023	Vagnozzi
Wendy Zhang	2023	Moore
Roxana Gutierrez	2023	Rissland
Gabriela Padilla	2023	Fantauzzo
Emily Gregersen	2024	Rotating

Nicole Costantino	2024	Rotating
Alyssa Powell	2024	Rotating
Sofia Gomez	2024	Rotating
Kaia Kinkel	2024	Rotating

VIII. CSD FACULTY ROSTER AUGUST 2024

Faculty	Primary Dept	CSD Students
Bruce Appel	Pediatrics	Abrams
Linda Barlow	Cell & Developmental Biology	Piarowski, Isner, Stenzel
Emily Bates	Pediatrics	Follmer
Richard Benninger	Bioengineering	
Kristen Boyle	Pediatrics	
Martin Breuss	Pediatrics	
Jim Bridges	Medicine, NJH	
Joseph Brzezinski	Ophthalmology	Ochoa Olmos, Purvis
Alexa Burger		
David Clouthier	Craniofacial Biology	Schuler
James DeGregori	Biochemistry & Molecular Genetics	Briggs, Johnson
Peter Dempsey	Pediatrics	Williams
Tobias Eckle	Anesthesiology	
Patricia Ernst	Pediatrics	
Katie Fantauzzo	Craniofacial Biology	Griffin, Padilla
Santos Franco	Pediatrics	Martin
Magda Gorska	Allergy and Clinical Immunology	
Adam Green	Pediatrics	
Lydia Heasley	Biochemistry & Molecular Genetics	
Ethan Hughes	Cell & Developmental Biology	
Srividhya Iyer	Orthopedics	
Sujatha Jagannathan	Biochemistry & Molecular Genetics	
Igor Kogut	Dermatology	
Edward Lau	Medicine	
Amanda Law	Psychiatry	
Shi-long Lu	Otolaryngology	
Traci Lyons	Oncology	
Wendy Macklin	Cell & Developmental Biology	
Susan Majka	Medicine, NJH	
Kristyn Masters	Bioengineering	
Jen McKey	Pediatrics	Folts
Michael McMurray	Cell & Developmental Biology	
Jeffrey Moore	Cell & Developmental Biology	Alemany, Brown, Zhang
Christian Mosimann	Pediatrics	Moran, Wells, Garfield
Jessica Nelson	Cell & Developmental Biology	Schloss
Jamie Nichols	Craniofacial Biology	Mumme-Monheit
Karin Payne	Orthopedics	
Chad Pearson	Cell & Developmental Biology	Collet, Schleicher
Eric Pietras	Hematology/Medicine	

Rytis Prekeris	Cell & Developmental Biology	
Tania Reis	Endocrinology, Metabolism, Diabetes	Cheng
Diego Restrepo	Cell & Developmental Biology	
Olivia Rissland	Biochemistry & Molecular Genetics	Rains, Gutierrez
Elle Roberson	Pediatrics	
Dennis Roop	Dermatology	
Brian Russo	Immunology and Microbiology	
Charles Sagerstrom	Pediatrics	Nunez
Stephen Santoro	Pediatrics	
David Schwartz	Medicine	
Julie Siegenthaler	Pediatrics	Kim
Emily Su	Obstetrics and Gynecology/Medicine	Ginocchio
Kelly Sullivan	Pediatrics	
Lori Sussel	Barbara Davis Center	Brooks, Hansen, Schaaf
Matthew Taliaferro	Biochemistry & Molecular Genetics	
Arianne Theiss	Medicine	
Ronald Vagnozzi	Medicine, Cardiology	Conradson, Stafford
Rajeev Vibhakar	Pediatrics	
Eszter Vladar	Pulmonary Sciences	
Kristin Watt	Craniofacial Biology	
Greg Way	Biomedical Informatics	Lippincott
Trevor Williams	Craniofacial Biology	
Michael Yeager	Bioengineering	
Ning Zhao	Biochemistry & Molecular Genetics	
Michael Zuscik	Orthopedics	Landgrave

64 active faculty members

IX. CSD 2024-2025 Committee Membership Roster

Jeff Moore, Director

Recruitment Committee
Jessica Nelson, Chair
Jamie Nichols
Elle Roberson
Mikaela Follmer, Student Rep
Lily Folts, Student Rep

Graduate Advisory Committee (GAC)
Jim Bridges, Chair
Sue Majka
Lori Sussel
Joe Brzezinski
Eszter Vladar
Christian Mosimann
Trevor Isner, Student Rep
Addison Rains, Student Rep

Curriculum Committee
Julie Siegenthaler, Chair
Greg Way
Arianne Theiss
Judy Cheng, Student Rep
Sophia Kim, Student Rep

Membership Committee
Matt Taliaferro, Chair
Peter Dempsey
Ron Vagnozzi
Eszter Vladar
Wendy Macklin
Lily Folts, Student Rep
Amanda Garfield, Student Rep

Journal Club
Mike Lippincott
Charles Griffin

Advanced Writing Workshop
Tina Piarowski
Ian Purvis

CSD Voices
Abi Mumme-Monheit
Maggie Keating

CSD 2024 Retreat Committee
Amanda Stenzel, Student Rep
Addison Rains, Student Rep
Bruce Appel, Faculty Rep

CSD Seminar Series
Linda Barlow, Chair
Katherine Fantauzzo
Chad Pearson
Peter Dempsey

Diversity, Equity and Inclusion (DEI) Coordinator
Santos Franco
Omar Ochoa, Student Rep

Steering Committee
Jim Bridges
Santos Franco
Julie Siegenthaler
Linda Barlow
Jess Nelson
Matt Taliaferro
Bruce Appel
Jeff Moore

Student Executive Committee
Trevor Isner, Chair
Tina Piarowski
Ian Purvis
Mikaela Follmer
Addison Rains
Amanda Stenzel
Sophia Kim
Judy Cheng
Abi Mumme-Monheit
Lily Folts
Mike Lippincott
Amanda Garfield
Charles Griffin
Maggie Keating

Appendix 1: Preliminary exam rubric

	KNOWLEDGE AND SCHOLARSHIP Identifies background and existing information.	**score:**
4	• Strong evidence of synthesis of concepts covered in coursework. • Terms, concepts, principles and methods are correct and described in depth. • Clearly identifies research problem in the field, based on prior knowledge. • Critiques prior work on the problem. • Demonstrates command of literature relevant to proposal. • Information presented is appropriately cited.	**comments:**
3	• Evidence of synthesis of concepts covered in coursework. • Terms, concepts, principles and methods are mostly correct and described with sufficient depth. • Identifies research problem in the field, based on prior knowledge. • Some critique of prior work on the problem. • Demonstrates familiarity with the literature relevant to proposal. • Most information presented is appropriately cited.	
2	• Some evidence of synthesis of concepts covered in coursework. • Terms, concepts, principles and methods are mostly correct but lacking important details. • Description of prior knowledge is adequate. • Describes, but does not critique prior work on the problem. • Demonstrates familiarity with the literature relevant to the proposal, but some relevant literature is neglected. • Information presented is cited, but could be improved.	
1	• Little to no evidence of synthesis of concepts covered in coursework. • Descriptions of terms, concepts, principles and methods are insufficient and/or incorrect. • Insufficient description of prior knowledge. • Insufficient description of prior work on the problem. • Insufficient incorporation of literature relevant to the proposal. • Information presented is rarely cited.	
	SCIENTIFIC REASONING AND EXPERIMENTAL DESIGN Describes hypothesis and experiments designed to test it.	**score:**
4	• Hypothesis is clearly stated, along with compelling rationale • Compelling rationale for experimental approach is provided. • Experiments are clearly described and appropriate. • Clearly describes controls and how they impact interpretation of the results. • Alternative experimental approaches are clearly described. • Clearly describes how results impact the hypothesis. • Identifies weaknesses in interpretation. • Alternative results are described, and impact on the hypothesis is considered.	**comments:**

3	• Hypothesis is stated and rationale is provided. • Rationale for experimental approach is provided. • Description of experiments is mostly clear and appropriate. • Controls and their interpretation are described. • Alternative experimental approaches are described. • Describes how results impact the hypothesis. • Alternative results are described and connected to the hypothesis.	
2	• Hypothesis is stated, but rationale is weak and could be improved. • Rationale for experimental approach is provided, but is unclear. • Description of experiments lacks some important details. • Controls are described, but description of interpretation is weak. • Alternative experimental approaches are described, but not developed. • Description of how the results impact the hypothesis lacks depth. • Alternative results are described, but not clearly connected to the hypothesis.	
1	• Hypothesis is unclear and rationale is weak. • Insufficient rationale for experimental approach. • Description of experiments is unclear or inappropriate. • Controls are poorly described. • Alternative experimental approaches are insufficiently described. • Insufficient description of how the results impact the hypothesis. • Alternative results are insufficiently described.	
	WRITTEN COMMUNICATION Communicates knowledge and reasoning through writing and graphics.	**score:**
4	• Writing is exceptionally clear and effective. • Graphics are well-organized. • Terms, concepts, principles and methods are used correctly.	**comments:**
3	• Writing is mostly clear and effective. • Most aspects of graphics are well-organized. • Most terms, concepts, principles and methods are used correctly.	
2	• Some aspects of writing are clear and effective. • Some aspects graphics are well-organized. • Some terms, concepts, principles and methods are used correctly.	
1	• Writing is unclear and ineffective. • Graphics are disorganized. • Terms, concepts, principles and methods are lacking and/or incorrect.	
	ORAL COMMUNICATION Communicates scientific knowledge and reasoning through speech and visual displays.	**score:**
4	• Oral communication is exceptionally clear and effective. • Graphics are well-organized. • Response to questions consistently incorporates appropriate evidence. • Response to questions is reflective.	**comments:**

3	• Most of oral communication is clear and effective. • Most graphics are well-organized. • Response to questions often incorporates appropriate evidence. • Response to questions with occasional prompting or “leading” required.	
2	• Some aspects of the oral communication are clear and effective. • Some aspects of the graphics are well-organized. • Response to questions incorrectly, even after prompting or “leading”.	
1	• Oral communication is unclear and ineffective. • Graphics are disorganized. • Fails to respond to questions.	

Appendix 2: GDDR T32 Trainee Selection and Reappointment

Trainee Selection and Reappointment

Each year, students are encouraged to apply to join the Genetics of Development, Disease and Regeneration (GDDR) T32 Training Program. Only CSD Program students who have passed their Preliminary Exam, are entering their second, third, or fourth year, and are working in the labs of GDDR Training Faculty will be eligible for support. Training Faculty and their mentees will submit the student's biosketch, statements of research goals and career goals, and a training plan written by the thesis mentor. The Trainee Selection and Oversight Committee will review nominations and identify six applicants for support from the T32. Each trainee will be supported for a maximum of 2 years, contingent on progress as determined by the Trainee Selection and Oversight Committee. While supported by the training grant, trainees are expected to submit abstracts and present their work at national or international conferences and participate in all GDDR functions, including the Roundtable, Developing Scholars Program, and Spring Symposium.

Applicant Eligibility

1. CSD Program student, or BSP or MSTP student who plans to join CSD
2. Mentored by a member of the GDDR Training Faculty (see list of current GDDR faculty below)
3. Entering 2nd or 3rd year of training. Students entering their 4th year of training will only be eligible for re-appointment.
4. Meets NIH T32 eligibility criteria

Application Materials and Application Process

1. Application materials will be submitted by email to Katherine Doyle (katherine.doyle@cuanschutz.edu).
2. Application deadline is August 12 by 5pm.
3. Mentors and mentees will jointly prepare and submit application materials.
4. Application materials will include:
    a. Applicant biosketch
        i. Find blank format page and samples for NIH Fellowship Biosketch here: https://grants.nih.gov/grants/forms/biosketch.htm
        ii. For part D. Scholastic Performance, please list only graduate courses.
    b. Description of research goals (one page or less). This description should focus more on concepts – what are the knowledge gaps, why are they important, what is needed to close them – and less on specific experimental details. This should be formatted as a narrative and **not** as a Specific Aims page.
    c. Description of personal and professional goals (one page or less). This should include goals for the period of T32 support, for Ph.D. training, and for the student's career.
    d. Training plan written by the faculty mentor (one page or less). This plan should be tailored to the student and include a description of the student's strengths, areas for improvement, and specific training for the thesis project.
    e. Trainees seeking reappointment for a second year of support will also submit a summary of accomplishments and contributions to the T32 program during the prior year of support, including but not limited to the following:
        i. Courses taken
        ii. Participation in roundtable, including a detailed description of your role in planning specific roundtable events.
        iii. Participation in symposium, including a detailed description of your role in the symposium.
        iv. Participation in the Developing Scholars Program, if applicable.
        v. Provide abstracts from presentations at conferences, and conference details (i.e., name, date, location).

vi. Fellowship applications submitted.
vii. Revised training plan written by mentor.

Selection Process

1. All members of the Trainee Selection and Oversight Committee will review all applications.
2. Applicants will be scored using a 1-9 NIH scoring scale on the following criteria:
    a. Prior academic performance in graduate courses
    b. Prior research accomplishments
    c. Clarity of research goals
    d. Clarity of personal and professional goals
    e. Clarity of training plan
    f. Strength of fitness with the training objectives of the GDDR T32

Application and Appointment Timeline

1. Application opens in July and closes on August 12.
2. Trainee appointments to the training grant will be announced by August 26.
3. Trainee appointments begin September 1

Appointment Strategy

The GDDR T32 will support six students annually. Each trainee is eligible for up to two years of support. To ensure continuity of junior and senior trainees, in the second year of the T32 a maximum of three of the original six trainees will be reappointed for a second year of support, thereby permitting appointment of three new trainees.

Trainee Oversight and Selection Committee

This committee will consist of the Director of the GDDR T32 Program and members of the Training Faculty chosen to represent the breadth of Program research interests and to include individuals from diverse backgrounds and different career stages.

GDDR Training Faculty, 2024-25

Chad Pearson	Charles Sagerstrom	Christian Mosimann
Emily Bates	Eric Pietras	James DeGregori
James Nichols	Jeff Moore	Joe Brzezinski
Katie Fantauzzo	Jess Nelson	Linda Barlow
Lori Sussel	Olivia Rissland	Rytis Prekeris
Sue Majka	Peter Dempsey	Ron Vagnozzi
Stephen Santoro	Bruce Appel	Santos Franco

Appendix 3: Comprehensive Exam Rubric

PURPOSE OF THE SCORING RUBRIC:

This scoring rubric is intended to help standardize the comprehensive exam process. Its purpose is to improve transparency, calibrate expectations, and to ensure that CSD students are treated equitably. Comprehensive exams are customized for each student, making the exam process inherently subjective and difficult to standardize. Nonetheless, this scoring rubric provides a framework for evaluating the student in the most objective fashion possible given the complexities of the exam. It is meant to have some flexibility.

SCORING RUBRIC:

This rubric contains examples of exam performance and should not be viewed as a strict checklist.

	KNOWLEDGE AND SCHOLARSHIP Identifies background, existing information, and reasoning.	**score:**
4	• Strong evidence of synthesis of concepts to support the thesis topic. • Terms, concepts, principles and methods are correct and described in depth. • Clearly identifies research problem in the field, based on prior knowledge. • Critiques prior work on the problem. • Demonstrates command of literature relevant to the thesis topic. • Information presented is appropriately cited. • Demonstrates independence in reasoning and understanding of the topic.	**comments:**
3	• Evidence of synthesis of concepts to support the thesis topic. • Terms, concepts, principles and methods are mostly correct and described with sufficient depth. • Identifies research problem in the field, based on prior knowledge. • Some critique of prior work on the problem. • Demonstrates familiarity with the literature relevant to the thesis topic. • Most information presented is appropriately cited. • Shows some independence in reasoning and understanding of the topic.	
2	• Some evidence of synthesis of concepts to support the thesis topic. • Terms, concepts, principles and methods are mostly correct but lacking important details. • Description of prior knowledge is minimal. • Describes, but does not critique prior work on the problem. • Demonstrates familiarity with the literature relevant to the thesis topic, but some relevant literature or preliminary data are neglected. • Information presented is cited, but could be improved. • Shows little independence in reasoning and understanding of the topic.	
1	• Little to no evidence of synthesis of concepts to support the thesis topic. • Descriptions of terms, concepts, principles and methods are insufficient and/or incorrect. • Insufficient description of prior knowledge. • Insufficient description of prior work on the problem. • Insufficient incorporation of literature relevant to the thesis topic. • Information presented is rarely cited/attributed. • Lacks independence in reasoning and understanding of the topic.	
	SCIENTIFIC REASONING AND EXPERIMENTAL DESIGN Written or oral description of hypotheses and experiments designed to test it.	**score:**

4	• Hypothesis is clearly stated, along with compelling rationale • Compelling rationale for experimental approach is provided. • Experiments are clearly described, powered, and appropriate. • Clearly describes controls and how they impact interpretation of the results. • Alternative experimental approaches are clearly described. • Clearly describes how experiments and results test the hypothesis. • Identifies weaknesses in interpretation. • Alternative results are described, and impact on the hypothesis is considered. • Statistics, rigor, reproducibility and sex as a biological variable are deeply considered and suitable to the thesis project.	**comments:**
3	• Hypothesis is stated and rationale is provided. • Rationale for experimental approach is provided. • Description of experiments is mostly clear, powered, and appropriate. • Controls and their interpretation are described. • Alternative experimental approaches are described. • Describes how experiments and results test the hypothesis. • Alternative results are described and connected to the hypothesis. • Statistics, rigor, reproducibility and sex as a biological variable are sufficiently addressed and suitable to the thesis project.	
2	• Hypothesis is stated, but rationale is weak and could be improved. • Rationale for experimental approach is provided, but is unclear or weak. • Description of experiments lacks some important details or is underpowered. • Controls are described, but description of interpretation is weak. • Alternative experimental approaches are described, but not developed. • Description of how experiments and results test the hypothesis lacks depth. • Alternative results are described, but not clearly connected to the hypothesis. • Statistics, rigor, reproducibility and sex as a biological variable are incompletely addressed.	
1	• Hypothesis is unclear and rationale is weak. • Insufficient rationale for experimental approach. • Description of experiments is unclear or inappropriate. • Controls are poorly described. • Alternative experimental approaches are insufficiently described. • Insufficient description of how experiments and results test the hypothesis. • Alternative results are insufficiently described. • Statistics, rigor, reproducibility and sex as a biological variable are not addressed.	
	WRITTEN COMMUNICATION Communicates knowledge and reasoning through writing and graphics.	**score:**
4	• Writing is clear and effective. • Graphics are well-organized and effective. • Terms, concepts, principles and methods are used correctly. • Writing takes full advantage of the student's preliminary data, experience, and/or the supporting literature. • Citations are organized, appropriate, and of sufficient depth.	**comments:**
3	• Writing is mostly clear and effective. • Most aspects of graphics are well-organized and effective. • Most terms, concepts, principles and methods are used correctly. • Writing partially takes advantage of the student's preliminary data, experience, and/or the supporting literature. • Citations are organized, but sometimes inappropriate or of limited depth.	

2	• Some aspects of writing are clear and effective. • Some aspects of graphics are effective or the graphics are incomplete. • Some terms, concepts, principles and methods are used correctly. • Writing poorly reflects the student's preliminary data, their experience, and/or the supporting literature. • Citations are poorly organized, inappropriate, or of insufficient depth.	
1	• Writing is unclear and ineffective. • Graphics are disorganized or lacking. • Terms, concepts, principles and methods are lacking and/or incorrect. • Writing does not utilize the student's preliminary data, their experience, and/or the literature. • Citations are unorganized, used inappropriately, or lacking.	
	ORAL COMMUNICATION Communicates scientific knowledge and reasoning through speech and visual displays.	**score:**
4	• Oral communication is exceptionally clear and effective. • Graphics are well-organized and effective. • The public seminar is highly effective, engaging, and on-time. • Response to questions (public and with the committee) consistently incorporates appropriate evidence and reasoning. • Response to questions is reflective and shows independent thinking.	**comments:**
3	• Most of oral communication is clear and effective. • Most graphics are well-organized and effective. • The public seminar is effective, but could be improved for clarity, engagement, or time. • Response to questions (public and with the committee) often incorporates appropriate evidence and reasoning. • Response to questions is correct after substantial prompting or "leading".	
2	• Some aspects of the oral communication are clear and effective. • Some aspects of the graphics are effective or the graphics are incomplete. • The public seminar is somewhat effective, lacks logical flow, or is inappropriately brief or long. • Response to questions frequently incorrect, even after substantial prompting or "leading".	
1	• Oral communication is unclear and ineffective. • The public seminar is ineffective. • Graphics are disorganized or lacking. • Routinely fails to answer questions correctly or coherently.	

Appendix 4. Template for Thesis Committee Meeting Progress Report

Written progress reports can be useful tools for structuring your committee meetings. It is recommended that you send your committee members a brief progress report ~1 week before your committee meeting. The goals of the progress report are to update your committee on your progress and accomplishments, identify any needs or concerns, and identify goals for the future. Below is a suggested format for your progress report.

Student Name:

Year started graduate school:

Year of comps:

Meeting date:

Last meeting date:

Committee members:

Thesis mentor:

Title of project:

Summary of progress since last meeting:

Thesis project:

Supporting projects/collaborations/pending publications:

Manuscripts:

Meetings, abstracts and form of presentation (poster/talk):

Fellowships/ Grants:

Other experience, accomplishments:

Potential timeline for the upcoming year and graduation:

Appendix 5: Example Individual Development Plans

Adapted from Duke University:

Building an Individual Development Plan

Individual Development Plans (IDPs) provide a way for you to plan how you will develop professionally and prepare for the next steps in your career. An IDP should be flexible enough to suit your interests and personal working style, and it should be rigid enough to ensure that you make active progress toward your goals.

IDP Steps

Step 1	Consider the skills, experiences, and qualities that are valued in your academic program(s) and in careers of interest
Step 2	Assess which of these skills, experiences, and qualities you want to improve long-term and short-term, and brainstorm specific experiences you can seek out
Step 3	Prioritize experiences to seek out and create SMART goals to ensure you make progress
Step 4	Discuss your IDP with mentors and others to gather feedback
Step 5	Implement your IDP and revisit it every 3-6 months

Step 1: How do you want to develop professionally?

Answer the following questions with lots of specific details. You can also include learning more about something as a quality you want to develop. For example, you can add "explore careers in science communication" to your career list.

What skills are required to be a successful student? What qualities are most valued?

What careers are you considering after PhD? What additional skills and qualities are valued in these careers?

Careers	Additional Skills & Qualities

Step 2: Setting Priorities and Gaining Experience

From the lists from Step 1, choose which skills, experiences, and qualities you want to develop in the short-term (the next 3-6 months) and which you want to build in the long-term (the next 1-2 years). Then, brainstorm different ways for you to gain experience in these areas.

Short-term Priorities

Skill/Quality	Potential Experiences

Long-term Priorities

Skill/Quality	Potential Experiences

Networking

Who Would Be A Helpful Contact?	Potential Ways to Meet

Career Exploration

What Careers Do You Want to Learn More About?	Potential Ways to Learn More

Self-Care

Activity, creativity, community, and spirituality

Ways You Care for Yourself	Potential Ways to Learn More

Step 3: SMART Goals

*SMART goals are **S**pecific, **M**easurable, **A**ccountable, **R**ealistic, and **T**ime-bound. Use the table below to outline your SMART goals to help you develop as a professional.*

Specific Goal	How Will Your Success Be Measured?	When Will You Complete This Goal By?	Who Will Hold You Accountable? How Will You Update Them on Your Progress?

Step 4: Mentors' and Others' Feedback

Gathering input from mentors and others can help you gain insight and set more effective goals. Mentors can include your advisor, faculty members at Duke and other institutions, fellow students, university staff, alumni and other professionals in careers of interest. Seek out a variety of formal and informal mentors who can provide insight on the skills and qualities you want to develop.

Who could you recruit as a mentor for your short-term and long-term goals? When could you meet with them to ask for feedback?

Potential Mentors	When/How to Ask for Feedback

Step 5: Implement and Revise

Start using your IDP. Be sure to set a reminder to revise your IDP every 3-6 months and seek additional feedback from mentors and others. You will likely need to revise and adapt some goals to better suit your needs along the way, which is perfectly fine and is to be expected.

Overview

Contributors	**Academic**
Contributors	**Leadership / Campus Involvement / Volunteer**
Contributors	**Career & Professional Development**
Contributors	**Self-Care**

Contributors	**IDP Goal 1**
Contributors	**IDP Goal 2**

Contributors: who provides you with advice, feedback, support, mentorship for these activities? Who are you engaging with?

Adapted from CU AMC Immunology Program:

Individual Development Plan (IDP)

A. Annual Progress Report

1. What were your main goals for the past year?

2. Which goals did you meet? If you did not meet a goal, why not?

3. List all major accomplishments this year in career development (e.g. presentations, publications, teaching, committees, course work, etc.). Include mentoring of graduate or undergraduate students in the laboratory.

4. Describe your level of satisfaction with your career development in the past year using a scale of 1-5 with 1 being highly satisfied. Provide a rationale for your choice.
   1 – Highly satisfied
   2 – Somewhat satisfied
   3 – Neither satisfied nor dissatisfied
   4 – Somewhat dissatisfied
   5 – Highly dissatisfied

B. Self-assessment

Core Competencies	No basis to evaluate	Needs development	Appropriate to career stage	Strength	*Adapted from ScienceCareers MyIDP, which is based on the National Postdoctoral Association's Core Competencies for*
Scientific Knowledge					
Broad based knowledge of science					
Deep knowledge of specific research area					
Critical evaluation of scientific literature					
Research Skills					
Technical skills related to research area					
Experimental design					
Statistical analysis					
Interpretation of data					
Creativity/innovative thinking					
Navigating the peer review process					
Communication					
Basic writing and editing					
Writing scientific publications					
Writing grant proposals					
Writing for nonscientists					
Speaking clearly and effectively					

Formulating and asking sound questions					
Presenting research to scientists					
Presenting to nonscientists					
Teaching in a classroom setting					
Training and mentoring individuals					
Seeking advice from advisors and mentors					
Negotiating difficult conversations					
Professionalism					
Demonstrating workplace etiquette					
Complying with rules and regulations					
Upholding commitments and meeting deadlines					
Maintaining positive relationships with colleagues					
Contributing to discipline (e.g. professional society member)					
Contributing to institution (e.g. committee participation)					
Management and Leadership Skills					
Providing instruction and guidance					
Providing constructive feedback					
Dealing with conflict					
Planning and organizing projects					
Time management					
Managing research resources responsibly					
Leading and motivating others					
Creating vision and goals					
Serving as a role model					
Responsible Conduct of Research					
Careful recordkeeping practices					
Understanding of data ownership/sharing issues					
Demonstrating responsible authorship/publication practices					
Demonstrating responsible conduct in human/animal research					
Able to identify and address research misconduct					
Able to identify and manage conflict of interest					
Career Advancement					
Creating and maintaining a professional network					
Identifying career options					
Tracking professional development and accomplishments (e.g. writing and maintaining a CV or résumé)					
Interviewing					

C. Goals for the Upcoming Year

1. In the upcoming year, what:

a. Publications do you plan to submit?

b. Meetings, conferences, and workshops do you plan to attend?

c. Fellowships or other funding applications do you plan to submit?

d. Collaborations do you plan to establish?

e. Other professional training or activities do you plan to participate in (e.g. teaching, university service, courses, internships, etc.)?

2. Career goals

a. Approximately when do you hope to finish your predoctoral training?

b. If you plan to finish within 12-18 months, estimate when you will begin a job or postdoctoral search.

c. What is your "Next Step" career goal (e.g. postdoctoral training, research job, science policy)?

d. What is your long-term career goal? (*ScienceCareers* MyIDP can help you evaluate your options in light of your interests and skills.)

e. What further training is required before it is appropriate to start a career search?

3. How can your PI help you achieve your goals for the upcoming year? What do you need from your PI?

Appendix 6: Tax preparation information

DISCLAIMER

Anschutz Medical Campus is not qualified to provide legal and/or tax advice. The information provided may or may not reflect recent revisions in IRS regulations. For tax advice on your specific situation, contact a tax professional. For additional information regarding the education tax credits. Please refer to the resources listed below for any additional help.

IRS Tax preparation help:

Anschutz website:

https://www.cuanschutz.edu/student-finances/billing-payments/1098-t-information-tax-year-2018-or-later

IRS relevant publications:

IRS Publication 970, Tax Benefits for Education (attached)

IRS Form 1098-T, Tuition Statement (Attached) *("Eligible educational institutions file Form 1098-T for each student they enroll and for whom a reportable transaction is made.")*

Please note:

1. 1098-T Information Tax Year is available in the Student Portal
2. W-2: depending on the source of your stipend, you will or will not automatically receive a W-2 for the University. (Typically, students who are appointed to a training grant or have independent fellowship support that provides a majority of the stipend amount will NOT automatically receive a W-2.)
3. Tax withheld: Depending on the source of your stipend, you will or will not have taxes withheld from your monthly distribution. (Typically, students who are appointed to a training grant or have independent fellowship support that provides a majority of the stipend amount will NOT have taxes withheld.) If taxes are not withheld, you are still responsible for making appropriate quarterly estimated tax payments.

I. From CU Anschutz website:

How to view the 1098-T Form:

" Log into UCDAccess

In your "Student Center", select "Student Account"

Select "View 1098-T" and select the year you want to view

The forms will be available only if you meet ALL of the following criteria:

- You have a valid, active home or mailing address on file at Anschutz Medical Campus.
- You have paid tax-reportable tuition, fees, or financial aid transactions on your account for that calendar year, including prior-year adjustments.

The items below are generally reported on the 1098-T.

- Paid Tuition
- Paid Mandatory Student Fees
- Paid Course/lab Fees
- Waivers
- Scholarships
- Grants

Items Not Reported on the 1098-T **(Be sure to keep and maintain receipts/documentation.)**

- Payments to or credits from the items below are NOT reported on the 1098-T. Unless noted otherwise, the IRS does not generally allow you to claim these items when calculating your allowable educational expenses and payments.
- College Opportunity Fund (COF) - The COF credit is not reported as a payment towards your tuition in Box 1, nor is it reported as a Grant or Scholarship in Box 5.
- Student Loans - If applicable, your loan provider will issue tax statements for deductible loan interest.
- Room and Board Expenses
- Fines (ie., parking, library, late fees)
- Tuition and Fees for Non-Credit Courses
- Anschutz Medical Campus Student Health and Dental Insurance Plans
- Books - per IRS guidelines, book charges and payments are usually tax deductible. For some courses taken at Anschutz Medical Campus, students are automatically charged for e-textbooks on their student accounts. Payments for those charges are included on the 1098-T form, UNLESS those charges were refunded due to approved appeals (ie., the books were purchased elsewhere) or the classes were dropped before the census deadline. For other book charges and payments not posted on the student account, those items will not be reported on the 1098-T form. ***Keep invoices and receipts of those transactions in your own tax records."***

II. IRS website information

1098-T (https://www.irs.gov/instructions/i1098et#en_US_2023_publink1000277119)

"Qualified tuition and related expenses.

Qualified tuition and related expenses are tuition, fees, and course materials required for a student to be enrolled at or attend an eligible educational institution.

The following are not qualified tuition and related expenses.

Amounts paid for any course or other education involving sports, games, or hobbies, unless the course or other education is part of the student's degree program or is taken to acquire or improve job skills.

Charges and fees for room, board, insurance, medical expenses (including student health fees), transportation, and similar personal, living, or family expenses."

Witholding and Tax Estimates. (https://www.irs.gov/faqs/estimated-tax)

"Question: How do I know if I have to file quarterly individual estimated tax payments?

Answer: Generally, you must make estimated tax payments for the current tax year if both of the following apply:

- *You expect to owe at least $1,000 in tax for the current tax year after subtracting your withholding and refundable credits.*
- *You expect your withholding and refundable credits to be less than the smaller of:*
  - *90% of the tax to be shown on your current year's tax return, or*
  - *100% of the tax shown on your prior year's tax return. (Your prior year tax return must cover all 12 months.)"*

The IRS website has a Witholding Tax Estimator: https://apps.irs.gov/app/tax-withholding-estimator

PhD Student Tax info on other websites

UCLA

https://biomedsci.ucsd.edu/students/financial-support.html#Are-my-stipend/salary-and-tuiti

"Though you will not receive a W-2 for your stipend income, **you are responsible for paying taxes on this amount**. You should be aware of this and plan accordingly.

- Free tax preparation assistance (domestic): http://www.irs.gov/Individuals/Find-a-Location-for-Free-Tax-Prep "

Vanderbilt. https://gradschool.vanderbilt.edu/funding/taxes.php

- "The IRS has a Free File site that can help you figure out if you can file your federal taxes for free and has the list of eligible online tax preparation companies or software. Some online tax preparation sites offer live, online support from tax experts. Turbo Tax is one option that has been used and recommended by students.
- The IRS's page on scholarships, fellowships, and other grants
- "Do I Include My Scholarship, Fellowship, or Education Grant as Income on My Tax Return?" "

Cornell. https://gradschool.cornell.edu/financial-support/tax-information/

Cornell-specific tax information:

- Understanding the 1098-T form
- 1098-T FAQ
- Fellowship recipients

All students:

- Internal Revenue Service

From Ask a Dean:

- Do graduate students have to pay tax on our health insurance plan? (March 2017)

- Are we taxed on our health insurance? (February 2019)

From Tips and Takeaways:

- Understanding Federal Taxes with Mary MacAusland, C.P.A., Ph.D.