

Cornell Combined DVM-PhD Program Pathway Student/Faculty Guidelines

Updated October 2024

The Combined DVM-PhD Degree program pathway (hereafter interchangeably referred to as “DVM-PhD Program” or “CD Program” for brevity) was created in 2002. It is based on an earlier Veterinary Scientist Training Program instituted in 1975. Students admitted to the DVM-PhD Program agree to meet the requirements and standards of the PhD and DVM training programs at Cornell University. Oversight of the CD Program is provided by a committee of graduate faculty in the College of Veterinary Medicine (CVM) with one member drawn from each of the five departments in the College. One member serves as the CD Program Director and Oversight Committee Chair. Current Combined Degree Oversight Committee (CDOC) membership is:

- Renata Ivanek Miojevic (DVM, PhD), CD Program Co-Director and CDOC Co-Chair, Department of Population Medicine and Diagnostic Sciences
- Kathryn Fiorella (PhD, MPH) Department of Public & Ecosystem Health
- Gunther Holoopeter (PhD), Department of Molecular Medicine, Graduate Field of Biomedical and Biological Sciences (BBS) Admissions Committee Chair
- Sabine Mann (DVM, PhD), Department of Population Medicine and Diagnostic Sciences
- Rory Todhunter (BVSc, PhD), CD Program Co-Director and CDOC Co-Chair, Department of Clinical Sciences
- Gerlinde Van de Walle (DVM, PhD), Department of Microbiology and Immunology
- Robert Weiss (PhD), Department of Biomedical Sciences

Additional committee members include:

- Peter Scrivani (DVM), Chair of the DVM Curriculum Committee, ad hoc member
- Jodi Korich (DVM), Associate Dean for Education, ex officio member
- Paula Cohen (PhD), Associate Dean for Research & Graduate Education, ex officio member
- Cynthia Leifer (PhD), Director of Graduate Studies (DGS) for BBS, ex officio member

Administrative support for the activities of the CDOC is provided through the Office of Graduate Education Manager and the Associate Dean for Research and Graduate Education in the CVM.

Admission into the DVM-PhD Program is the joint responsibility of the CDOC, the DVM Admissions Committee, and the BBS PhD Program Admissions Committee. Academic oversight for the DVM program is provided by Dr. Jody Korich, Associate Dean for Veterinary Education. Jennifer Mailey in the Office of DVM Admissions at the CVM provides support for DVM-PhD. Academic oversight for the PhD program is provided by Drs. Renata Ivanek Miojevic and Rory Todhunter, Co-Directors of the CD program, and the DGS for BBS. Arla Hourigan in the Office of Graduate Education (OGE) at the CVM provides support for DVM-PhD Program students during their PhD studies.

Abbreviations used in this document:

BBS=Graduate Field of Biomedical and Biological Sciences

CD Program= Combined DVM-PhD Degree Program Pathway

CDOC=Combined Degree Oversight Committee

CUHA= Cornell University Animal Hospital

CVM=College of Veterinary Medicine

DGS=Director of Graduate Studies

DVM=Doctor of Veterinary Medicine

DVM-PhD Program= Combined DVM-PhD Degree Program Pathway

MSTP=Medical Scientist Training Program

OGE= Office of Graduate Education

PhD= Doctor of Philosophy

VIP=Veterinary Investigator Program

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I. INTRODUCTION

Our academic objective is bold: we seek to integrate the most rigorous basic scientific and clinical training so that our graduates will be at the forefront of biomedical science and the veterinary profession in academic research, medicine and teaching; government service and public health; or the biotechnology/pharmaceutical industry. Our Program takes advantage of Cornell's uniquely interdisciplinary environment to integrate clinical training in veterinary school with the University's internationally-recognized strengths in biochemical, cellular and molecular biology, biomedical engineering, cancer biology, epidemiology, ecology, food sciences, genomics, infectious disease and immunology, nanotechnology, neurosciences, zoology wildlife conservation and One Health among others.

For students, the benefits of Cornell's Combined DVM-PhD Degree Program Pathway include:

- training in basic sciences to improve fundamental biological understanding and to learn how to ask and test scientific questions appropriately;
- acquisition of a systems knowledge of anatomy, physiology, medicine and surgery that will enable students to understand biological processes and disease conditions from subcellular to organismal levels;
- understanding of the similarities and differences between species, enabling students to utilize comparative approaches to science and medicine;
- clinical training which facilitates identification of areas in need of research to benefit animal and human health;
- integration of basic science and clinical studies to decrease the time required to earn two advanced degrees in an environment where outstanding DVM and PhD training is available;
- financial support during the DVM studies currently consists of health insurance and an annual stipend consistent with the NIH predoctoral rate (currently \$27,144). In addition, the CVM will forgive all loans associated with the DVM tuition when both the DVM and PhD are completed. If a student is already in the DVM program when accepted in the CD program, the DVM tuition will be covered for the years that the student was part of the CD program;
- financial support during the graduate studies consisting of graduate school tuition, stipend and health insurance provided by the faculty mentor

Clinical medicine and laboratory research have many rewards – but also potential frustrations. The CVM's DVM-PhD program recognizes that a scientific career is a challenging undertaking. In addition to those common among all professional careers, there are particular challenges associated with combined-degree careers because the training is long and it is difficult to manage the conflicting demands of clinical, laboratory and personal responsibilities. During your training, we provide guidance for how to plan your studies, and suggest ways to deal with many problems you are likely to encounter, while attempting to preserve the flexibility necessary to permit integration and completion of two advanced degrees in a timely manner.

The Cornell DVM-PhD program is centered in the CVM and is comprised of the College's DVM Professional Program and Cornell's Graduate School. The unique structure of the CD Program provides you with extraordinary resources and opportunities. It also is a source of challenges that we hope to minimize with this Guide. **Please note, this is only a guide** – not a substitute for the policies that govern your education and training in the DVM Program or in your PhD field. These policies will be reviewed annually and updated regularly. It is your responsibility to abide by them for each of the training components as they are applied during the period in which you are enrolled. While it is the intention of all involved to honor agreements made at the time you matriculate in the DVM-PhD Program, some changes in the Veterinary Medicine curriculum may occur that are particular to the DVM class you are associated with. These may include, but are not limited to, addition or deletion of distribution courses and changes in scheduling of clinical rotation and distribution course blocks. During the graduate program, most of the guidance in this document is based on expectations for students in the graduate Field of BBS, which is part of the Biomedical and Biological Sciences (BBS) Program based in the CVM.

II. GOALS AND ORGANIZATION OF THE COMBINED DVM-PhD DEGREE PROGRAM PATHWAY

The goal of the DVM-PhD Program at Cornell University is to train the next generation of leaders in biomedical research – and to do so in a manner that promotes an effective intellectual dialogue between students and faculty researchers and clinicians. Graduates of the DVM-PhD Program will have excellent research credentials and be well qualified for the practice of veterinary medicine if they decide to combine research with veterinary practice. This program is designed to be completed in on average 8 years (see Appendix A). Thus, considerable interplay of DVM and PhD studies is necessary for the student to make efficient progress through the program. Successful integration of PhD and DVM studies requires an appreciation that the mission of the graduate program and the professional curriculum are not entirely congruent. This section of the guidelines is an introduction to how the DVM-PhD Program attempts to combine important parts of graduate and veterinary medical studies. In addition to a set of milestones below, strong proactive mentoring (see section III) is essential for students to complete the program in a timely way. A detailed overview of required and elective training activities and the competencies and skills acquired through each activity, are explained Appendix F. These training activities were designed for CD Program as part of the Cornell University Combined DVM-PhD Medical Scientist Training Program (MSTP, 2023-2028).

A. Elements of the Training Program

The main components of the DVM-PhD Program are the DVM studies comprised of course work, laboratory exercises and clinical training, and PhD studies which include laboratory rotations, graduate courses, proposal writing (A-exam), thesis research and writing, and thesis defense (B-exam). An outline of the 8 years of the training program can be found in Appendix A.

Summary of requirements for continuation of enrollment in the CD Program:

1. Maintain a B average per semester (GPA of 3.0) in the DVM and PhD curriculum
2. Identify and gain entry into a lab for your PhD studies that has adequate funding to support your tuition, health insurance, stipend and research costs
3. Provide a 6-month PhD program progress report for review by the CDOC during the first year of your PhD studies
4. Pass the A exam within 2 years of entering the PhD program
5. Comply with graduate field requirements
6. Demonstrate a commitment to combined research and DVM studies

Most CD Program students are required to do their first research rotation during the summer of Year 1. In consultation with the CD Program Director and the DGS of BBS, the student should arrange for a research rotation as soon as they matriculate into the program. It is imperative that the student rotate in labs that have sufficient funding for research and that can financially support a graduate student. For this summer rotation, the student will be part of Cornell Veterinary Investigator Program (VIP) and receive a stipend (see Appendix B). This first research rotation should be completed by mid-August prior to entering the DVM program.

The second research rotation is completed during the distribution period A/B at the beginning of the spring semester. The student should register for 4 credits of research during that period. The third research rotation is completed during the summer between year 1 and 2 of the DVM program. Stipend support for the summer will be arranged by Associate Dean for Research and Graduate Studies and may be through one of the organized programs: VIP, the Cornell Leadership Program (see Appendix B), or another mechanism. Again, students should consult with the CD Program Director(s) and the DGS before submitting their rotation selection so that they can ensure a rotation that is worthwhile to the student's career goals. At the end of this third rotation, the student should select a thesis mentor in consultation with the CD Program Director and the DGS. All CD Program students admitted before or during the first year of their DVM training are required to select a thesis mentor before entering the 2nd year of the DVM program. Considering that students are admitted through the BBS program and that the CVM provides considerable financial support to CD Program students, students must remain registered within the graduate field of BBS and the thesis mentor must be a member of that field.

The Research Years: DVM-PhD Program students must keep contact with the Office of Graduate Education (OGE) and Paige Frey, the CVM College Registrar, to ensure they make smooth transitions between the DVM Program and the Graduate School. It is important to note that the administrative mechanics will change to the Graduate School once in the PhD Degree Program and all program requirements must be fulfilled according to the Graduate School.

DVM-PhD Program students are advised to select their Special Committee during the first 2 months of their PhD program. The function of this committee is to guide students and evaluate their progress. Detailed information about this committee can be found in section V-C.

A first committee meeting should be scheduled within the first 6 months of the graduate program. This way, the student, their advisor, and the committee members can discuss the plans for the thesis research and any other issues that might be relevant. Thereafter, the committee should meet at least once a year. A progress report must be completed and distributed to the committee members, to the OGE, and to the CD Program Director before the meeting, no later than July 1st of each year. In addition, the results of the meeting must be distributed to the same entities.

<https://www.vet.cornell.edu/education/biomedical-biological-sciences-bbs-phd-program/combined-dvmphd-program/curriculum>

These first 6 months of PhD training are critical in setting the student on a productive path towards completion of the PhD. As such, the student will submit to the CDOC a brief report (1 page, bullet points) after 6 months in the graduate program outlining what they have accomplished, what they plan to accomplish in the next 6 months and whether the project is going in a productive direction, or if a new direction is being formulated.

After completing three semesters of PhD study the student will prepare a formal research proposal for their Special Committee and defend it in an oral examination (the A-exam). The A-exam proposal format is specified in the guidelines published by the graduate field on their website. The A-exam should be completed within the first two years of the graduate program. See section VII-D for more details.

Students are responsible for scheduling their Special Committee meetings and the A-Exam. It is the policy of the DVM-PhD Program that a student who fails to convene their Special Committee annual meeting by the end of their first year of PhD studies will be considered in poor academic standing, unless they have received explicit permission to have the meeting, or exam, at a later date. All students are strongly encouraged to make sure that their Committee meets in a timely manner, and that the reports are submitted to meet this deadline. Given the difficulties associated with coordinating committee members, students are advised to begin scheduling the Committee several months in advance of the meeting – and to send out reminders. If the student, or their Committee, is concerned about the rate of progress, it is advised that Committee meetings be scheduled twice a year, so that the rate of progress can be monitored more closely. The decision of whether the student can defend their thesis usually would be made during a Committee meeting.

Students are expected to have completed their thesis research and thesis document before returning to the DVM curriculum by the end of their fourth year of graduate studies. However, if a student in good standing is not ready to return to the DVM program at that time, and they have sufficient evidence that they will be able to finish their research if granted an additional year, they may petition the CDOC and the DVM Curriculum Committee for a 1-year extension of their thesis research period. If they fail to do this in a timely way, they must return to the DVM class. Failing to petition, or return to the DVM class, will require reapplication for admission to the DVM program. Information regarding petitions can be found in Appendix C. While not as common, students can also decide to complete their PhD in 3 years (provided that all the requirements of the PhD degree are met).

Students that receive approval for a 5th year of graduate studies are required to submit to the CDOC a progress report after 4 months into the additional year outlining what they have accomplished in those 4 months and what their plan is to finish up their thesis by the end of the year. This will enable the CDOC to provide enhanced guidance during this critical point in the student's graduate studies.

Completion of the DVM program. CD Program students are expected to return to the veterinary curriculum in the Spring semester of the second year of their DVM program. In the summer preceding their return to the DVM curriculum, students must inform Dr. Jai Sweet and registrar Paige Frey of their intentions.

Students may TA in one of the foundation courses in the DVM curriculum during their years in the PhD Program. This is important to maintain the integration of the veterinary and graduate research curriculum.

B. Important Milestones

- Begin seeking guidance from the CD Program co-Directors and from the DGS of BBS within weeks of acceptance into the DVM-PhD Program to select a laboratory for their 1st research rotation
- Successfully complete one summer research rotation prior to entering the DVM Program (via VIP)
- Continue seeking guidance from the CD Program Director and DGS to select 2nd and 3rd research rotations
- Complete a second research rotation during the winter intercession or spring distribution period of year 1
- Complete a 3rd research rotation during the summer between years 1 and 2 of the DVM program
- Choose a research mentor by the end of the third rotation
- Begin the PhD Degree Program in January of Year 2
- Form a Special Committee within 2 months of starting graduate studies
- Have a Special Committee meeting within 6 months of starting graduate studies
- Take the A-exam before the end of the first 2 years of graduate studies
- Take elective and the BBS required graduate courses while in graduate school
- Take the B-exam before returning to the DVM curriculum
- Return to the DVM curriculum in January of Year 6
- Finish the DVM program in May of Year 8

C. Timeline Alternatives and Exceptions

Needless to say, the CDOC strongly prefers students to apply for, and be accepted into, the CD Program as part of their DVM application prior to entering the DVM program. However, other paths have been followed. Students who matriculated into the DVM curriculum or to PhD program at Cornell and are admitted to the CD Program will have essentially the same timeline as other CD students.

- 1. DVM Students Entering the DVM-PhD Program* would have to demonstrate their commitment to research, either by having participated in the VIP or Leadership Programs, and/or doing research part time while in the DVM curriculum. The number of research rotations required will be pro-rated by the number of labs they have done research projects in before being accepted into the program. Thus, it is likely that 1st year DVM students will be credited with one research rotation. They will be expected to complete their additional research rotations by the end of the summer after entering the program and select a thesis mentor.
- 2. Cornell Graduate students Entering the DVM-PhD Program* are expected to have completed 3 laboratory rotations and selected a research mentor prior to starting the DVM curriculum. During the first year of DVM program these students are expected to pursue thesis research during summers and Distribution Course periods.
- 3. Extending the Thesis Research Period.* If a student, their research mentor and their Special Committee are in agreement that the student's research will benefit significantly by a one year extension of the research period, or if their research would be jeopardized by leaving a highly competitive ongoing project in an unfinished state, the student must submit a written petition first to the CDOC, which will judge its suitability for support before its presentation to the DVM Curriculum Committee (see Appendix C).
- 4. Extenuating Circumstances.* The CDOC recognizes that life is not always smooth and sometimes extenuating circumstances will arise that will alter the most carefully laid plans. Students are encouraged to consult with their research mentor, the DVM-PhD Program co-Directors, and/or the DGS regarding any difficulties that they may encounter that are likely to affect their progress through the Program.

D. Financial Support

During the DVM program, an individualized financial support package is prepared annually for each student by the Director of Student Financial Planning, Kristin Pennock. Part of the financial aid package includes a loan for DVM tuition from the CVM starting the year that the student enters the program. The loan is forgiven once the DVM-PhD Program students successfully complete both their DVM and PhD degrees. The College will provide health insurance and stipend during the DVM program.

DVM-PhD Program students receive full graduate tuition, health insurance and stipend support from research funds supplied by their faculty research mentor/PhD committee chairperson from the beginning of the student's PhD program. Therefore, it required to select a research mentor whose funding is sufficient to cover these funds for the duration of

the PhD. It is also expected that students will apply for graduate funding to an appropriate funding agency (e.g., NIH, USDA). During the fall semester of Year 3, students will take BIOAP 6100, a 3-credit course in which they will write a research proposal to be submitted for external funding. During the spring semester of year 3 students will take BIOAP 7100. Topics for this course will include; hypothesis development, scientific design, critical evaluation of literature, and oral defense. Additional BBS PhD curriculum requirements include [VTBMS 7200 - BBS Seminar - Work-in-Progress \(WIP\)](#) and BIOMG 7510 - Ethical Issues and Professional Responsibilities.. (see section IX, Administrative Issues)

III. GUIDANCE AND COUNSELING FOR DVM-PhD PROGRAM STUDENTS

A. General Guidelines for Finding Support Personnel and Resources

The OGE, which is managed by Arla Hourigan generally should be the starting point for all information gathering by DVM-PhD Program students – particularly for students in their early years in the Program. Each student will also be assigned a current DVM-PhD Program student as mentor. In addition, the DVM Office of Student Services, which is directed by Dr. Jai Sweet, is a resource for CD Program students.

The Co-Chairs of the CDOC act as the CD Program Directors. They serve as an effective liaison between the DVM Program and the Graduate School. Questions relating to academic guidance usually are referred to the CD Program Directors or the DGS. In addition to these formal mechanisms, DVM-PhD Program students are encouraged to consult with their faculty research mentor and student advisors.

B. Faculty Advisor (during DVM training)

Each student in year 1 of the DVM program is assigned a Faculty Advisor. The DVM Student Handbook, published annually in the College, contains a list of all of the requirements, policies and opportunities that pertain to your DVM education. Because the DVM curriculum is highly structured, with a list of required courses and laboratories, students do not always choose to consult with their assigned faculty advisor. Rather, they self-select one or more faculty advisors on an informal basis and consult directly with Paige Frey, the College Registrar regarding scheduling of courses and clinical rotations. However, it is your faculty advisor who will be your advocate if for some reason you have any concerns with a course leader or circumstances require you to bring a formal appeal to the College faculty. It is important to inform a member of Dr. Jai Sweet's office if you change your faculty advisor. You should also inform the OGE and the program director about your faculty advisor.

C. The Advisory Committee

The directors of the program and the DGS of BBS will begin advising students before the first summer rotation. Students need to select their thesis research advisor by the end of the second summer. When a student selects a thesis mentor, the directors of the program and the DGS will communicate to the student and the mentor the expectations and responsibilities of the student and mentor in the DVM-PhD program.

D. The Graduate Special Committee

This committee of graduate faculty is established by the student and their research mentor (see section V-B, Choosing a Thesis Advisor,). The purpose of this Graduate Special Committee is to guide the student through their PhD training. DVM-PhD Program students are on an accelerated track when they enter their research years, and it is advised that they select their Special Committee no later than 6 months into their graduate studies. The function of this committee is to guide students and evaluate their progress. More detailed information about this committee can be found in section V-C.

IV. THE VETERINARY MEDICINE CURRICULUM

A. Overview

The professional veterinary curriculum at Cornell reflects the leading edge of scientific knowledge and clinical medicine. It is comprehensive, interdisciplinary, and continually evolving to prepare veterinarians to pursue diverse career paths within the veterinary profession including basic and/or translational research. It provides a broad-based education in all of the traditional subjects and, in an era of increasing specialization, gives students the opportunity to develop an area of greater expertise. In addition to a strong foundation in biomedical and clinical disciplines, the educational program also emphasizes important related topics in veterinary medicine including communication skills, client relations, ethics, public health, practice management, and professional development.

The goals of the professional veterinary curriculum at Cornell are to:

- provide each student with the knowledge and skills that form the foundation on which to build a career in the profession;
- foster critical thinking and scientific curiosity;
- inculcate a rigorous approach to problem-solving;
- emphasize the scientific principles underlying veterinary medicine;
- foster habits of self-education and lifelong learning;
- stress preventative as well as curative medicine;
- promote ethical behavior and a sensitivity to the role of the veterinarian in society;
- provide each student with a broad general veterinary education, but also the opportunity to pursue an area of interest from among the many opportunities available to veterinarians;
- teach students to recognize the limits of their skill and knowledge and to make effective use of additional resources and expertise.

Course descriptions are found at the following website:

http://courses.cornell.edu/preview_program.php?catoid=12&poid=3518

V. GRADUATE STUDY

The three major Graduate School requirements for the PhD degree are six semesters of study, two oral examinations (the A and B exams) and the written dissertation. DVM-PhD Program students are admitted to the graduate Field of BBS.

Graduate students are expected to:

1. Make an original and substantial contribution to their field of research.
2. Demonstrate in-depth knowledge of one sub-discipline in their field.
3. Demonstrate a broad knowledge of theory and research across several sub-disciplines.
4. Learn and follow ethical guidelines for research scientists and academic professionals.
5. Write and speak effectively to professional and lay audiences about major issues in their research area.

DVM-PhD Program students are expected to complete 3 research laboratory rotations and select a thesis research mentor before entering the second year of the veterinary curriculum. Major differences between traditional graduate education and the DVM-PhD are that DVM foundation courses contribute a greater breadth of knowledge, while graduate courses are designed to explore unsolved problems that can be addressed by employing the scientific method. To achieve the goals for any researcher, whether they earn PhD or DVM-PhD degrees, requires them to understand that their success in achieving a depth of knowledge in any subject is proportional to their efforts to educate themselves.

A. Laboratory Rotations

DVM-PhD Program students are required to rotate through the laboratories of three graduate faculty members prior to selecting their Special Committee Chair. Although the time spent in each laboratory may vary between 8 and 10 weeks, it is expected that each rotation will be a meaningful experience. Students are strongly encouraged to discuss potential rotations with the DGS and CD Program Directors. When selecting rotation laboratories, students should review faculty web sites, read their recent research publications, and meet with selected faculty members to discuss potential rotation projects and inquire about the financial capacity of the lab to support a PhD student. There is a compressed timeline for the PhD component of the CD Program so that it is in the student's own interest and that of the CD Program, in general, to select lab rotations with this pragmatism in mind.

Each student and faculty mentor is required to complete an evaluation form at the end of each rotation:

<https://www.vet.cornell.edu/education/biomedical-biological-sciences-bbs-phd-program/current-students/curriculum/lab-rotations>

B. Choosing a Thesis Advisor

Any faculty member of a graduate field associated with the BBS program can serve as the research advisor for DVM-PhD Program students. It is important to recognize that the student-mentor relationship should be one where there is trust

and mutual respect since it is going to be a close working relationship for the years of the research, and beyond when you are looking for future training and employment. Typically, the research mentor is also the Chair of the Special Graduate Committee, but this is not obligatory, as any member of the graduate faculty can serve as Chair. For example, if two labs are collaborating closely with you on your project, you may be doing most of your research in one laboratory, but your committee chair may be your main collaborator. For the CD Program, the responsibility for a student's research guidance and progress rests with the head of the laboratory in which the student is working. The thesis advisor is responsible for the following:

- Providing financial support for the PhD degree portion of the program, to include stipend in accordance with the BBS stipend level, tuition and health insurance
- Providing ongoing research mentorship throughout the program
- Providing support in all research-related costs
- Providing laboratory space and access to necessary research equipment, research and office space

C. Graduate Special Committee

A student's PhD degree program is developed and supervised by a Special Committee. This committee will be composed of 4-5 members:

- The Chairperson who directs the student's thesis research. If the Chair is not the research mentor, it is expected that the research mentor also be a member of the Special Committee.
- Two faculty members representing two minor concentrations (a major minor and a minor minor). The student is encouraged to form a committee that will bring breadth and diversity to their training.
- A field appointed member. The field appointed member is a voting member of the graduate field whose role is to ensure the fulfillment of high standards during the student's training.
- A member of the CDOC. This member must be a current member of the CDOC at the time the Special Committee is formed. This person may or may not be the Field appointed member, but they cannot be the student's research advisor or chairperson. This person is the student's advocate on the committee. Their role is to ensure the student has an adequate path to graduation, and has fulfilled all requirements of BBS (in conjunction with minor member 2). For example, at the 4th year meeting, this person should be asking what is the plan for graduation, and how the student's paper is progressing. Most importantly, should there arise a dispute between the student and chair, this person should provide his/her input on the student's progress to balance the discussion, and provide an external view of the student's progress. This person should also bring any potential disputes or problems to the attention of the DGS, who can help mediate.
- Once constituted, the committee must be registered with the Graduate School.
- A student may propose changes in the Committee composition as their research interests evolve. Any such changes must be approved by the Graduate School.

It is the responsibility of the student to hold a formal meeting annually with the members of their Special Committee. During the first meeting of the Special Committee, the student will present their research plan to their committee and the committee will suggest appropriate foundational coursework. The opportunity to participate in elective coursework may be limited by the compressed timeline of the CD student's PhD. Annual research progress reports to the Special Committee, which will be shared with the CDOC, will be the basis for their continued guidance during the PhD training period. The progress review form can be found at: <https://www.vet.cornell.edu/education/biomedical-biological-sciences-bbs-phd-program/current-students/curriculum/student-progress-review> The reports are due on April 1st of each year.

D. Graduate School Requirements and Field Recommendations

The Graduate School has very few specific requirements for the PhD degree. Official requirements are purposely minimal since graduate education at Cornell University is considered to be the purview of the Graduate Faculty serving on the Special Committee which includes a field appointed member to ensure that program expectations are met. DVM-

PhD Program students are in the Field of BBS and its members follow the guidelines of the BBS program in the CVM. Students are expected to do the following:

- Conduct an Annual Meeting of the Special Committee (deadline: April 1st). Individual reports by the student and the mentor should be submitted to each committee member prior to this meeting. A report of the meeting must be submitted to the Office of Graduate Studies by the Field-appointed member or by a minor member of the committee. The form for these reports can be found at: <https://www.vet.cornell.edu/education/biomedical-biological-sciences-bbs-phd-program/current-students/curriculum/student-progress-review>
- Take the Admission to Candidacy Exam (A-Exam): Before the end of Year 3 of the program (i.e., one year after joining the PhD component of the CD program), the PhD student must prepare and defend a research proposal before their Special Committee in order to be admitted to doctoral candidacy. This examination is comprised of a written and an oral exam. The passing of this examination certifies that the student is eligible to present a dissertation to the graduate faculty. Normally students have completed their course requirements before taking the A Exam. An exception may be made by the student's Special Committee if a student has not yet taken a recommended course that was not offered during their first three years as a graduate student. More information on the A exam can be found in the BBS internal docs folder (located on Cornell box) <https://cornell.app.box.com/folder/77119724095?s=6bsu3s8il5nhdodq6fghoxkqb4p1imlq>
- Thesis Defense (B-Exam): This is an oral examination by the Special Committee based on the content of the Ph.D. dissertation and the expectations of scholarship in the student's discipline. A minimum of two registration units must be earned between passing the A exam and the B exam.
- A doctoral candidate takes the B-exam upon completion of all requirements for the degree but no earlier than one month before completing the six semester requirement.
- Thesis Document: DVM-PhD Program students must present a dissertation of acceptable scholarship and literary quality. A relatively polished draft of the thesis including all tables, figures, appendices and references must be presented to all members of the Special Committee at least five business days before the final examination. The duration of the period reserved for the reading of the dissertation is to be established by the members of the committee with the student in advance of scheduling the B-exam. Acceptance of the thesis or dissertation requires the approval of all the Special Committee members.

E. Publications

It is the expectation that DVM-PhD Program students will have at least one first-author publication in press in a peer-reviewed journal by the time they graduate from the PhD Program. Additional publications before or following the B-exam are a hallmark of a strong thesis. The exact expectations vary by the area of study and are decided by the Special committee.

VI. INTEGRATION OF DVM AND PhD STUDIES

The purpose of a temporal intermingling of DVM and PhD training is to facilitate an intellectual synergy between the scientific and clinical disciplines. It is also anticipated that this program will allow students to reduce the overall time it takes to earn both degrees sequentially.

Research may be conducted during the DVM curriculum in the form of laboratory rotations during summer breaks, during 4-8 week periods in distribution blocks. During PhD training, students are encouraged to maintain their clinical skills by completing their teaching assistantships in clinical laboratories and periodically volunteering for supervised clinical training. Students should plan on spending up to approximately 10% of their effort during their PhD dedicated to clinical opportunities in agreement with their PhD mentor.

A. Research during DVM program

Two of the three laboratory rotations are completed during summer breaks from the DVM program through two structured programs that foster critical thinking skills (see Appendix B). Both programs feature discussions with exceptional researchers from Cornell and outside.

CD Program students are encouraged to take advantage of an elective Clinical and Translational Scientist certificate through the NIH-funded Clinical and Translational Science Award One Health Alliance (COHA) program, designed to

address gaps in integrating clinician/translational scientist training into the DVM-PhD research training nationally (Appendix F: see in attached Appendix 3 c2).

B. Clinical Training During PhD

Clinical Specialist Program is uniquely designed for CD Program students, to provide them with exposure to clinical medicine during their PhD training (Appendix F: see in attached Appendix 1 d4).

CD Program students can additionally participate in formal and informal veterinary experiences up to 10% of their time while enrolled in the PhD portion of their program. Oversight of the types of opportunities chosen, the timing of the experiences and the number of hours dedicated to clinical opportunities is the responsibility of the CD program student and their PhD thesis mentor. Identified options include, but are not limited to, informal shadowing in clinical labs, e.g., junior surgery, wildlife clinics, as well as opportunities to participate in, and audit, clinical service rotations. The latter occurs on a daily basis in different specialty services throughout the year. Case presentations are made by 4th-year vet students, residents, or faculty members. The case presentation and discussion center on animals that are currently under clinical care. The presentations include a complete history of the animal, imaging, and clinical summaries of how the case has been handled to date. Opportunities are subject to permission from the clinical lab/service coordinator.

C. Teaching Requirement

All BBS students are required to complete a one-semester teaching experience. The Office of Graduate Education coordinates teaching assistantship assignments each year. As a CD Program student, you should seek opportunities to teach in veterinary courses that you have already taken.

VII. EVALUATION

A. Grade Expectation

Satisfactory academic performance for a DVM-PhD Program student is fulfilled when a student has received a B grade average or better in a given semester. Please note that the level of an acceptable grade in the DVM program is lower than in the PhD or DVM-PhD programs. For this reason, a DVM-PhD Program student's progress may be considered inadequate, while their work may be deemed adequate in the DVM program.

The CDOC conducts an annual review of the academic standing of all students. Any student who has not met program academic expectations should expect an informal warning or a letter from the CD Program Directors depending upon the level of concern provoked by poor grades and/or poor research progress. Written notification will include an invitation to the student to explain the circumstances of their academic deficiency to the CDOC. This may stimulate a formal review of the student's suitability for the combined degree program.

B. Laboratory Rotation Evaluations - by professor and student

For each research laboratory rotation the head of the lab will submit a written report on the students' performance to the OGE, and they are shared with the CDOC. The student will also evaluate their research experience in the lab. More information can be found at: <https://www.vet.cornell.edu/education/biomedical-biological-sciences-bbs-phd-program/current-students/curriculum/lab-rotations>

C. Annual Progress Reports [Student Progress Review (SPR)]

It is the responsibility of the student to have an annual meeting with their Special Committee. Individual reports by the student and the mentor should be submitted to each committee member prior to this meeting. A report of the meeting must be submitted to the Office of Graduate Studies by the field appointed member or by a minor member of the committee. More information can be found at: <https://www.vet.cornell.edu/education/biomedical-biological-sciences-bbs-phd-program/current-students/curriculum/student-progress-review>

D. Admission to Candidacy Examination (A-exam)

The A-exam consists of a written and oral component, and the student is expected to be entirely responsible for developing both components. The written format is typically a fellowship, generally similar to an NIH R21 application. Students will be provided written guidelines for the A-exam as part of the handbook. For the oral part of the exam, the primary format will be a chalk talk. The purpose of using a chalk talk format is to enable focusing on the student's thought process rather than on the data. Students will have practice with the chalk talk format through BioAP7100,

whose explicit goal is to prepare students for the A-exam. More information on the A exam can be found in the BBS internal docs folder (located on Cornell box)

<https://cornell.app.box.com/folder/77119724095?s=6bsu3s8il5nhdodq6fghoxkqb4p1imlq>

E. Defense of Thesis (B-exam)

The Special Committee reads the thesis, attends a public presentation by the degree candidate, and administers an oral examination on the subject matter presented. The Special Committee decides if the student passes, fails or receives a conditional pass; this becomes part of the record with the Graduate School.

VIII. TRANSITIONS

A. Matriculation into the DVM-PhD Program

Are you a DVM-PhD Program student or a DVM or PhD student? You are all things at all times! You will work in the laboratory and be in the classroom during the first year and a half of veterinary professional training. You will be co-mingled with a large class of DVM students and become a full-fledged member of that class. You will be graduating in a different DVM class than you started in.

B. From Professional Program to Graduate School

Your DVM Program is predictable and your life is structured by the curricular demands. Laboratory research, in contrast, is inherently less structured and routinely obtaining good quality data takes practice. You need to identify a suitable thesis project, which despite the best planning may turn out to be a dead end – or cause unexpected difficulties. You also will worry about how you will “fit” into the laboratory: will you get along with your advisor; will your thesis project continue to excite you? These concerns are common for all PhD students. Even though the concerns are real, they are manageable – and your predecessors in the program have managed them successfully!

C. From Graduate School Back to the Professional Program

The transition from Graduate School back to the Professional Program poses yet another shift. You leave the relative freedom of the laboratory for the structure of the clinical training, where you are part of a team and where your activities are to a large extent dictated by your responsibilities to your patients. It is difficult to make the transition from a recognized expert in your field of research to a (somewhat unprepared “rusty”) DVM student. You have been away from the Professional Program for 3 or 4 years, or more. Fortunately, you are reentering the DVM Program in Block 5a, which may be described as the pre-clinical lectures and labs. Do not underestimate the impact of what you have learned during your thesis research and how it will help you in the clinic. Your animal handling and procedures skills may be rusty, but the depth of understanding you bring to the practice of medicine should be enhanced.

D. From the DVM-PhD Program to Postgraduate Clinical/Postdoctoral Training

The search for internship and residency programs, or for a post-doctoral research position is another daunting goal post. You will apply when you have been through only a fraction of your clinics, and you are likely to be uncertain about your goals. You may also feel that your skill set is not as developed as it should be. The decisions you make are important, but medicine and biomedical research are changing rapidly, and nobody can plan for more than three years, or so, into the future. Maintain as much flexibility as possible. Remember the postgraduate clinical training programs are looking for clinicians, people who take good care of patients. That you are trained in research is a plus, but no amount of research training (or publications) will make up for a poor record in your Professional Program! **Grades matter, and it is important to “make a good impression” – as a future clinician.**

IX. ADMINISTRATIVE ISSUES

A. Funding

DVM-PhD Program students will receive substantial financial incentives to complete both degrees. Stipends during the DVM years will be funded by CVM or NIH and will be the NIH predoctoral rate, while stipends during the PhD years will be in accordance with the BBS PhD Program rate and will be funded by the faculty mentor. Graduate school tuition and fees will be paid by the student's faculty mentor during the PhD portion of the program. However, the College will provide a tuition loan for the veterinary school tuition covering the years that the student is part of the program, which the College will forgive once both the DVM and PhD degree programs are completed. Health insurance, through

Cornell's SHP (Student Health Plan), will be provided throughout the length of your Combined Degree training. While a DVM student, the CVM will pay for this. While a graduate student, the faculty mentor will provide support for health insurance.

B. Interview/Recruitment/Mentorship

DVM-PhD Program students participate in the interview/recruitment of new CD Program students during BBS recruitment event (in late January / early February). They can also be asked to mentor the new students coming into the program.

C. Publications and Acknowledgments

Students, who are /have been supported by any fellowship, should acknowledge that support as well as the source of funds supporting the research in any publications. Money begets money; previous funding support is a sign of success. Students should provide the OGE with the URL of their publications as these are compiled with materials outlining the outcomes of the program.

D. Vacation

Students may take an annual vacation in accordance with policy set by the Graduate School and their research mentor. Although, vacation time during the DVM years will follow the academic calendar and the policy of the DVM Program, as a DVM-PhD Program student you are expected to consult with your research mentor regarding vacations. For students doing their thesis research, the timing of vacations should be agreed upon between the student and thesis advisor. Grievances can be brought to the CD Program Director. Graduate students appointed on any combination of full assistantships or fellowships for spring, summer, and fall terms are entitled to two weeks (ten weekdays) of annual vacation each 12-month period (August 21 through August 20) in addition to Cornell University holidays (when the university is officially closed); vacation time will be prorated for students appointed for shorter periods of time (e.g., 4 days for a student appointed on an assistantship or fellowship for only one semester during the calendar period August 21-August 20). University holidays generally include twelve days: Martin Luther King Jr. Day, Memorial Day, Independence Day, Labor Day, Thanksgiving and the following day, and winter break (generally six working days from December 25 through January 1). Days on which classes are not in session but the university is open (e.g., institutionally-scheduled academic breaks in Fall Semester, January intersession, Spring Semester) are not automatic vacation time nor holidays for graduate students appointed on assistantships, but graduate students appointed on assistantships may request in advance to take a vacation during such periods.

E. Sick Leave

As a PhD Degree student, you may continue to receive stipends for up to 7 days of sick leave per year. In consultation with your faculty mentor, additional arrangements can be made. If there is a greater need for time away due to illness, the student should consult with the Office of Graduate Education to discuss a health leave of absence.

F. Parental Accommodation

While in the PhD degree program, students may receive a six-week paid accommodation for parental needs surrounding childbirth, adoption, newborn care, foster care, and acute child health care (or eight weeks for the birth mother for a cesarean section delivery).

The use of parental accommodation must be requested at least 90 days in advance of the anticipated beginning, please see [this website](#) for maternity and paternity options. There is no parental leave for DVM students; student will need to take a Leave of Absence from the DVM Program.

G. Unpaid Leave

While in the PhD degree program, students requiring extended periods of time away from their training experience, which could include more than 7 days of sick leave and/or more than 56 days of parental leave, must seek approval from the chair of their Special Committee and from the CD Program Director for an unpaid leave of absence. Whenever possible, approval for a leave of absence must be requested in advance of the leave.

H. Withdrawal from the Program

Students who contemplate withdrawal from the DVM-PhD Program should recognize that withdrawal has serious repercussions, as they will lose all DVM-PhD Program "privileges" including stipend and tuition support. Assuming they otherwise are in good academic standing, and with the permission of the CD Program Director, students who withdraw

from the CD Program can matriculate in the Professional Degree Program or the Graduate School, where they will be subject to the policies and graduation requirements that apply to single-degree DVM or PhD students.

I. Protection of Intellectual Property Rights

A student may not enter into any legal agreement involving their research without consulting their advisor and the CD Program Director. Many organizations and investigators that supply research materials, which could be in the form of access to proprietary databases, insist that a Materials Transfer Agreement, or a similar document, be signed by the recipient. These are legal documents, and their wording may place (severe) restrictions on the use, and outcome of any use, of the supplied materials. Therefore, do not view such documents lightly, and do not sign any agreement that has the potential to limit your rights to any discovery without seeking advice. Generally, students should avoid signing any such documents and refer the matter to their advisor.

Appendices

Appendix A: Outline of the 8-Year Training for DVM-PhD Program Students

Year	Summer	Fall	Spring
1	1 st Research rotation	DVM Year 1	DVM Year 1 2 nd Research rotation
2	3 rd Research rotation	DVM Year 2	PhD -Begin work in mentor's lab -Form special committee
3	PhD -Special committee meeting report due July 1 st	PhD	PhD
4	PhD -Special committee meeting report due July 1 st	PhD A-exam	PhD
5	PhD -Special committee meeting report due July 1 st	PhD	PhD
6	PhD -Special committee meeting report due July 1 st -Petition for an extra year out of DVM if necessary	B-exam PhD -Finish thesis	DVM Year 2
7	DVM Year 3	DVM Year 3	DVM Year 3
8	DVM Year 4	DVM Year 4	DVM Year 4

Appendix B. Getting Started: Summer Programs and Research Rotations

Students are expected to complete all necessary information required to matriculate in the DVM program as per the Cornell DVM Program guidelines, and communicated by that office. While it is possible to enroll in the DVM program before completing a bachelor's degree, all students enrolling in Cornell's graduate school are required to have completed a bachelor's degree or equivalent before they matriculate, and the Graduate School must have received final, official degree bearing transcript(s) from the undergraduate institution(s).

First Summer and Second Summer. The DVM-PhD Program requires newly accepted students to complete their first research rotation in the summer before entering the DVM program. Students should apply to the Cornell Veterinary Investigator Program (VIP) by January 31st to ensure that their summer research rotation is organized before they arrive, and to receive a summer stipend. Incoming students are requested to consult with the CD Program Director and the DGS of BBS before submitting their VIP rotation selection. It is imperative that students rotate in labs that are well-funded and that can assume the responsibility of training a new graduate student.

1. Cornell Veterinary Investigator Program (VIP)

The VIP program is designed to provide first- and second-year veterinary students with a focused biomedical research experience. The main objectives of the program are to provide veterinary students with a rigorous and rewarding exposure to biomedical research at the highest level of inquiry and to motivate students to pursue the study of research problems that are relevant to veterinary medicine. Specifically, each student will develop:

- research skills
- an appreciation for the value of biomedical research in veterinary medicine
- a desire to pursue a career that involves biomedical research

More information is found at: <https://www.vet.cornell.edu/education/other-educational-opportunities/veterinary-investigators-program-vip>

2. Leadership Program for Veterinary Students

The Leadership Program for Veterinary Students at Cornell University is a unique summer experience for those who seek to broadly influence the veterinary profession through a science-based career. It is an intensive, research-oriented program combining faculty-guided research with vocational counseling, student-directed learning, and other professional enrichment activities. Approximately 25 veterinary students from the United States and abroad are accepted into the program annually. Qualified applicants are highly motivated individuals who have distinguished themselves in a variety of professional and personal pursuits. The life experiences, culture, and academic backgrounds of qualified applicants are diverse, but all possess the ability to become future leaders in academic veterinary medicine and the biomedical sciences at large. More information is found:

<https://www.vet.cornell.edu/education/other-educational-opportunities/leadership-program-veterinary-students-cornell-university>

Appendix C. Advice on Preparing Petitions

There are two times during your CD Program that you may be asked to prepare formal petitions. Here are the procedures and tips in order to prepare a successful petition.

1. Research for DVM Course Credit

DVM students may register for research in the (VTMED 6X99) distribution block periods, for up to 4 credits per year for a total of 11 credits. For DVM-PhD Program students, this opportunity is most useful in their 1st year of the DVM program when they are seeking to complete their 2nd lab rotation.

The appropriate form can be obtained from the College Registrar, Paige Frey. You will need to provide a brief description of your research objectives and you will need the signature of a faculty member in the CVM. If your research will be done in the laboratory of someone who is not on the College faculty, you should request that a CDOC member or a member of your Special Committee signs the form. Please be aware, the person signing the form is responsible for your grade, even if it is an S/U. You must meet with them to discuss your research on whatever schedule they suggest or you may not receive credit for your work.

2. Extension of Thesis Research Period

The goal for completing the DVM-PhD Program training is eight (or seven) years. To accomplish this, students take a 4(3)-year leave from the DVM program to do their thesis research before returning to the DVM curriculum. We recognize that each student's training program will be unique, and that it is difficult to predict the rate of progress. Students therefore are encouraged to consult with their research mentor and the CD Program Director regarding any difficulties that they may encounter that are likely to affect their progress through the Program.

According to a policy approved by the CVM faculty in 2022, if a student in good standing is not ready to return to the DVM program after 4 years of thesis research, and they have sufficient evidence that they will be able to finish their research in a 5th year, they may petition the CDOC and the DVM Curriculum Committee for a 1-year extension of their thesis research period. If they fail to do this in a timely way, they must return to the DVM class. Failing to petition or return to the DVM class will require reapplication for admission to the DVM program.

Procedures:

Please submit your petition to the CDOC in the summer of Year 6. Do not hesitate to seek advice from a CDOC member while preparing this document.

- Items to include in the petition:
 - Summary of current research project.
 - Plans for additional year of research (including timetable).
 - Address how veterinary skills will be maintained during this period.
 - Letter of support from Special Committee Chair.
- Student submits petition to the CDOC for review and their vote.
 - Student will receive communication from the CDOC.
 - If approved, CDOC will inform the DVM Curriculum Committee of their endorsement and ask them to review and vote on the petition as well.
 - Both the CDOC and DVM Curriculum Committee need to approve the petition.

Appendix D: DVM Curriculum

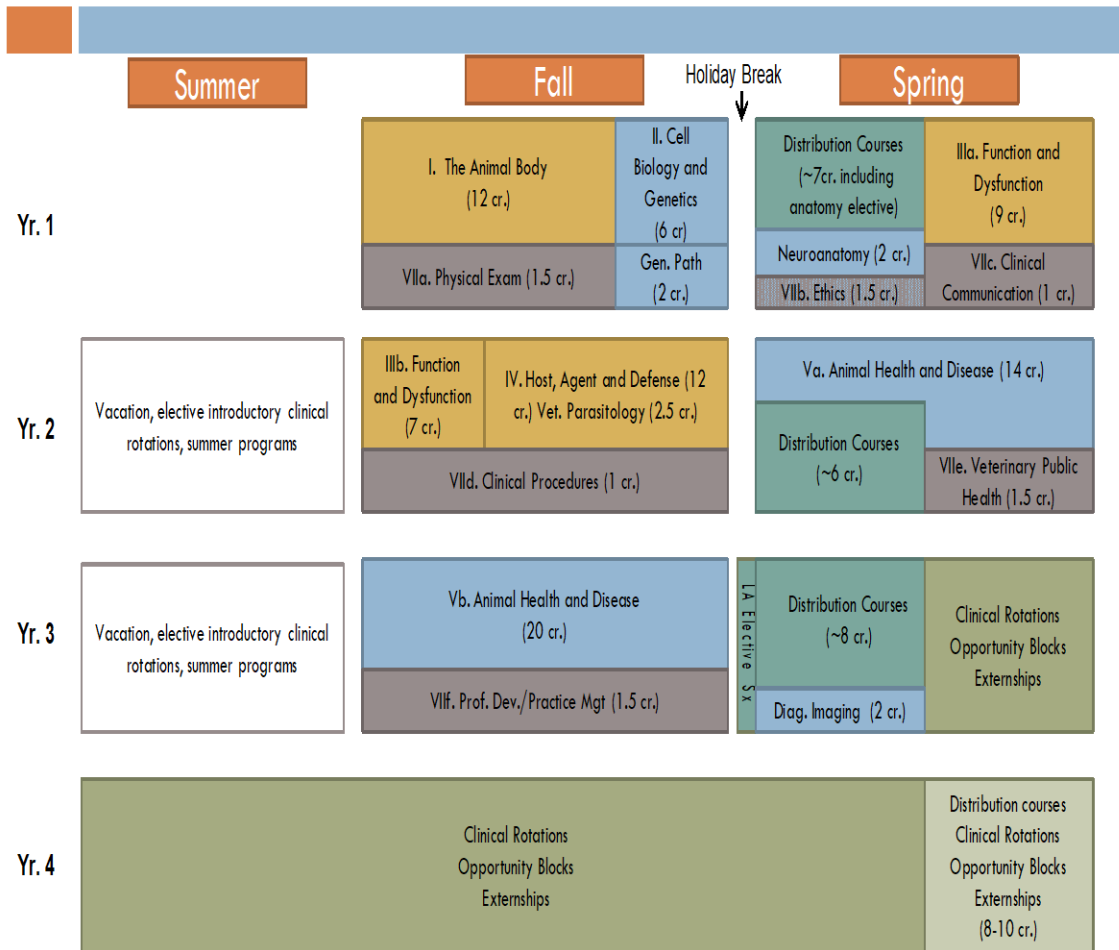
Notation: PBL=problem-based learning

DVM Curriculum Overview

Foundation Course using PBL

Other Pre-clinical Foundation Courses

Course VII: Veterinary Practice



Updated 11/2017

Appendix E. Professional Conduct

As DVM-PhD Program students you are entering a profession, and you will from your first day in the Program be regarded as junior members of that profession. You should behave accordingly. The term Professional Conduct has many implications and all students should familiarize themselves with the Cornell Code of Academic Integrity and the Honor Code of the DVM Program.

The aim of the Code is to foster an atmosphere of academic and professional integrity, in which each individual accepts responsibility for their behavior. The Code establishes norms that will guide you as you struggle with the, at times difficult, moral and ethical questions that will arise in your career as a biomedical investigator. The nature of the questions that arise will change over time, as will your own appreciation of the issues involved; but the basic principles will remain invariant.

Some norms are self-evident, such as the absolute prohibition against plagiarism and other scientific misconduct. Other norms are more subtle, such as those pertaining to your interactions with your colleagues, advisors and other faculty, and eventually your patients. This involves three related issues: how you behave, how you communicate, and how you treat the information you receive.

You are in training to become a clinician-scientist, which means that you will have clinical responsibilities – at least while you are completing your clinical training in the Professional Program. You will be responsible for your patients' lives and well-being, which means that you must have the competencies needed to practice your chosen profession. You also have special responsibilities in terms of how you behave toward your patients – you show compassion and respect. Your interactions with colleagues and faculty should be at the same high level.

Science progresses because scientists exchange information, and it is important that you communicate accurately, effectively and with appropriate consideration for the people you communicate with. This requirement goes beyond the mere exchange of scientific information; it applies to all your professional interactions – including those pertaining to your medical education and clinical activities – from your first day in the Program.

You will be the beneficiary of confidential information: fellow students will discuss their newest results and you will exchange information about different laboratories; at lab meetings you learn about your colleagues' exciting results; you read their grant applications and manuscripts; and you will be given manuscripts to review for journals. Some of the information that comes your way can be disseminated freely; but much of the information is privileged, meaning that it can be disseminated only with the explicit approval of the individuals who gave you the information. If you are in doubt whether some information is privileged, you should assume it to be so until you have permission to discuss it with others. Breaches of confidentiality are serious violations of professional conduct. You need to use your judgment – at all times!

This combination of competency, honesty and confidentiality is the hallmark of professional integrity.

Finally, as DVM-PhD Program student you have many privileges. These privileges are not entitlements; you must earn them – by performing at a consistently high level. Noblesse oblige!

Appendix F. Detailed Overview of Training Activities in the DVM-PhD Program

Training Activities Overview

The overarching goal of the CD program is to develop a diverse pool of well-trained veterinary clinician-scientists who have the disciplinary knowledge, as well as the clinical, technical, operational, professional, and self-development skills (**Figure 1**) that will uniquely prepare them for leadership roles in biomedical research to advance health at the individual and population levels. A detailed overview of training activities, including a list of all required and elective activities and the competencies and skills acquired through each activity, are depicted in **Figure 2**. These training activities were designed for CD Program as part of the Cornell's Combined DVM-PhD Medical Scientist Training Program (MSTP, 2023-2028). They are explained in the attached **Appendix 1: Required activities** and **Appendix 3: Elective activities**. Additionally, training in reproducible and responsible conduct of research are described in the attached (i) **Appendix 2: Responsible Conduct of Research Syllabi**, (ii) **Plan for Instruction in the Responsible Conduct of Research (RCR)**, and (iii) **Plan for Instruction in Methods for Enhancing Reproducibility (R&&)**.

Training activities in this CD program, both required and elective, are purposefully designed to accommodate the unique needs of each individual and to foster their strengths and interests. **Figure 3** shows two representative examples of individualized students' training schedules.

Figure 1. Training in six major competency domains and underlying skills.

Competency Domain (CD)	Disciplinary knowledge (K)	Clinical skills (C)	Experimental/research skills								Professional skills (P)				Development skills (D)	
			Technical (T)			Operational (O)					Communication	Leadership & Teamwork	Grantsmanship	Mentoring & Teaching		Entrepreneurship
Skill Name	Discipline-specific foundation knowledge	Patient care clinical skills	Appropriate methods	Technologies	Quantitative/computational approaches	Independent knowledge acquisition	Rigor & Reproducibility in experiments (R&R)	Interpretation of data	Responsible conduct of research (RCR)	Proper animal use/care; Lab Safety					Communication	
Skill No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Figure 2. Activities in the CD Program. Competency domains: **K**= Disciplinary knowledge; and **C**=Clinical; **T**=Technical; **O**=Operational; **P**=Professional; and **D**=Self-Development skills. Skills 1-16 are explained in **Figure 1**.

Goal	ID	Name	Activity	New	Competency domains and skills (Figure 1)																Described in	
					K	C	T			O					P					D		
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Develop biomedical science leaders																						
<i>Basic Science Training</i>	1	DVM Foundation Courses I to IV, VII			R	R	R	R													App.1: b1	
	2	Foundational graduate courses			R		R	R														App.1: b9
	3	Course in programming/scripting and/or quantitative approaches		New R			R		R		R	R										App.1: b8
	4	Participation in journal clubs and seminar series					R	R	R		R											App.1: c1
	5	BBS Signature seminar series (BBS-cubed) with a trainee-hosted scientist					R	R	R						R							App.1: c2
	6	Annual BBS Program Graduate Research Symposium and Poster Day					R	R	R		R	R	R		R	R		R				App.1: d2
	7	BIOGM 7510: Ethical Issues and Professional Responsibilities				R					R	R	R	R		R						App.1: b5; 2; RCR
	8	Annual refresher RCR training by Cornell Office of Research Integrity				R					R	R	R	R								RCR
	9	Instruction in Methods for Enhancing Reproducibility									R	R	R									R&R
	10	BIOAP 6100: Skill Building for a Career in the Life Sciences I									R		R					R				App.1: b2
	11	BIOAP 7100: Skill Building for a Career in the Life Sciences II									R		R		R		R					App.1: b3
	12	VTBMS 7200: Biomedical and Biological Sciences Seminar - WIP									R	R	R		R							App.1: b4
	13	BIOGM 7941: Skills development for Scientific Proposal Writing		New R							R		R		R		R					App.1: b6
	14	Proper use and care of vertebrate animals & Training in lab Safety				R							R	R								App.1: b7
	15	Electives in programming/scripting and/or quantitative approaches					E		E		E	E										App.3: a1
	16	ALPHA workshop on machine learning		New E			E		E		E	E										App.3: a2
	17	Opportunities to gain teaching skills and experience		New E	E		E	E		E		E			E	E		E		E		App.3: b6
	18	BBS Student Community Programs													E	E		E		E		App.3: b4
	19	Attend National Veterinary Scholars Symposium (NVSS) and CD Colloquium					E	E		E	E	E	E		E	E		E		E		App.3: c4
<i>Leadership training</i>	20	Seminar on Team Science		New R										R	R						App.1: c4	
	21	COMM 5660 - Science Communication Workshop		New R											R	R		R				App.1: c3
	22	During PhD: Annual completion of an Individual Development Plan (IDP)								R	R	R	R		R	R		R				App.1: d1
	23	Participate in trimonthly veterinary research career discussions		New R											R	R		R				App.1: c5
	24	Combined degree dinner meetings and annual summer retreat		New R											R	R						App.1: d3
	25	LEAD 3100: Foundations in Leadership													E	E						App.3: b1
	26	NBA 5150 Leadership Theory and Practice.													E	E						App.3: b2
	27	INFO 5431 Teams and Technology.													E	E						App.3: b3
	28	Opportunities to communicate scientific research across disciplines, public													E	E		E		E		App.3: b5
Optimize DVM and PhD training integration																						
<i>DVM & PhD intermingling</i>	29	CD training years: 1.5 DVM + 4 (or 3) PhD + 2.5 clinical DVM training			R	R																
<i>Research during DVM</i>	30	First rotation: Veterinary Investigator Program (VIP)					R	R	R	R	R	R	R	R	R						App.1: a1	
	31	Second rotation: VTMED 6899: Research Projects in Veterinary Medicine					R	R	R	R	R	R	R									App.1: a2
	32	Third rotation: Leadership Program (LP) or CTSC Summer Fellowship		New R			R	R	R	R	R	R	R	R	R	R						App.1: a3
	33	Research for credit: VTMED 6899: Research Projects in Veterinary Medicine					E	E	E	E	E	E	E	E								App.1: a2
	34	COHA Clinical and Translational Scientist certificate		New E	E				E	E		E	E	E	E	E	E					App.3: c2
<i>Clinical training during PhD</i>	35	Cornell MSTP Clinical Specialist Program		New R	R					R		R			R						App.1: d4	
	36	Annual survey of clinical experiences during the PhD			R																	R
	37	Informal shadowing in clinical labs, e.g., junior surgery, wildlife clinics			E																	E
	38	Opportunities to participate in, and audit, clinical service rounds			E																	E
Expand opportunities for career development																						
<i>Careers in academia</i>	39	Burroughs Wellcome Fund (BWF)'s "Becoming Faculty" workshop													E	E					E	
<i>Careers beyond academia</i>	40	Attending the annual alumni Cornell CD Career Panel		New R											R	R			R	R	App.3: c5	
	41	Cornell Hackathons													E	E			E	E		App.3: d1
	42	Trainings by Center for Veterinary Business & Entrepreneurship		New E											E	E			E	E		App.3: d2
	43	Participate in the Cornell Careers Beyond Academia program													E	E						E
total R activities/skill					3	7	9	8	4	8	13	12	13	7	15	9	3	4	1	11		
total E activities/skill					1	3	5	3	3	4	5	5	3	2	12	12	1	4	2	14		

Notations: **New**=Activity that is new and/or unique in Cornell CD program; **R** (pink square)=Required activity; **E** (yellow square)=Elective activity; **App.**=Appendix; **RCR**=Instruction in the Responsible Conduct of Research; **R&R**= Instruction in Methods for Enhancing Reproducibility.

Figure 3. Schedules for Two Example Students in the CD Program: student **A** started CD Program before DVM year 1 and is interested in a research-oriented job in industry & entrepreneurship; student **B** started CD Program at the start of DVM year 2 and is interested in a tenure track faculty position. Green boxes indicate the training as part of the CD Program; Gray box is training before matriculation into the CD Program. Black: required activities; Blue: elective activities (min. of 5).

Year	Student A (matriculated before DVM year 1)	Student B (matriculated at the start of DVM year 2)
	1 st research rotation (VIP, summer)	VIP (optional)
1	Foundational courses: VTMED 5100 & 5200 (fall) ; 5300 & 5701-3 (spring) 2 nd research rotation	(VTMED 6899, spring)
	3 rd research rotation (LP or CTSC, summer)	
2	Foundational courses: VTMED 5310, 5400, 5410 & 5704 (fall) BBS PhD courses: BIOMG 7510 (spring) & VTBMS 7200 Instruction in the proper use and care of vertebrate animals & Training in lab Safety (spring) <u>Newly implemented</u> PhD course: BIOMG 7941 (spring) Participation in journal clubs and seminar series, including BBS-cubed <u>CD-unique</u> : dinner meetings & trimonthly veterinary research career discussions Cornell MSTP Clinical Specialist Program Annual BBS Program Graduate Research Symposium and Poster day (summer) <u>CD-unique</u> : Annual summer retreat (summer)	
3	BBS PhD courses: BIOAP 6100 (fall), BIOAP 7100 (spring) & VTBMS 7200 <u>Newly implemented</u> PhD course: course in scientific programming/ quantitative analysis Participation in journal clubs and seminar series, including BBS-cubed <u>Newly implemented</u> PhD course/seminar: COMM 5660 & seminar on Team Science (fall) Annual completion of IPD (fall) <u>CD-unique</u> : dinner meetings & trimonthly veterinary research career discussions Annual alumni Cornell CD Career Panel & Cornell MSTP Clinical Specialist Program Annual BBS Program Graduate Research Symposium and Poster day (summer) <u>CD-unique</u> : Annual summer retreat (summer)	
4	BBS PhD courses: VTBMS 7200 Participation in journal clubs and seminar series, including BBS-cubed A-exam Annual completion of IPD (fall) <u>CD-unique</u> : dinner meetings & trimonthly veterinary research career discussions Annual alumni Cornell CD Career Panel & Cornell MSTP Clinical Specialist Program Cornell Careers Beyond Academia COHA Clinical & Translational Scientist certificate Professional skill course: LEAD 3100	
	Annual BBS Program Graduate Research Symposium and Poster day (summer) <u>CD-unique</u> : Annual summer retreat (summer)	
5	BBS PhD courses: VTBMS 7200 Participation in journal clubs and seminar series, including BBS-cubed Annual completion of IPD (fall) <u>CD-unique</u> : dinner meetings & trimonthly veterinary research career discussions Annual alumni Cornell CD Career Panel & Cornell MSTP Clinical Specialist Program Cornell Hackathons Teaching skill opportunities CVBE training events Science communication across disciplines Teams & Technology course: INFO 5431 Professional skill course: LEAD 3100	
	Annual BBS Program Graduate Research Symposium and Poster day (summer) <u>CD-unique</u> : Annual summer retreat (summer) BWF 'Becoming Faculty' workshop (summer)	
6	Participation in journal clubs and seminar series, including BBS-cubed Annual completion of IPD (fall) Thesis defense (B-exam) (fall) <u>CD-unique</u> : dinner meetings & trimonthly veterinary research career discussions Foundational courses: VTMED 5500 & 5705 (spring)	
7	Foundational courses: VTMED 5510 & 5706 (fall) VTMED 5520 & distribution courses (spring) <u>CD-unique</u> : dinner meetings & trimonthly veterinary research career discussions CVBE training events & Hackathons COHA Clinical & Translational Scientist certificate	
8	Clinical Rotations & Opportunity Blocks & Externships <u>CD-unique</u> : dinner meetings & trimonthly veterinary research career discussions CVBE training events & Hackathons COHA Clinical & Translational Scientist certificate	

Attachments adopted from Cornell's Medical Scientists Training Program (MSTP):

Appendix 1: Required Training Activities

Preamble

The Combined DVM-PhD (CD) training plan has been carefully designed to interface the trainee's thesis research with the training structure of the DVM program and the BBS graduate field. All CD trainees are enrolled through the BBS Graduate Umbrella Program. This Program provides a consistent training experience for all graduate trainees in the biomedical sciences during the first 8 to 9 months of their training and official requirements for the PhD degree are purposely minimal since graduate education at Cornell University is considered to be the purview of the graduate faculty serving on the trainee's special committee.

The **25 required training activities** of this MSTP training grant, outlined below, are geared towards producing well-trained clinician-scientists with skills in **six main competency domains: (1) disciplinary knowledge, (2) clinical skills, (3) technical skills, (4) operational skills, (5) professional skills and (6) self-development skills** (experimental/research skills comprise (3) and (4)) that will uniquely position them for leadership roles in biomedical research. To reach this goal, the MSTP training grant includes **8 required training experiences that are newly implemented, new, and/or uniquely designed for CD trainees.**

a. Research Rotations

All CD trainees are required to rotate through a minimum of two mentor laboratories (each rotation lasts between 8 to 12 weeks) before selecting their PhD advisor by fall semester of their second year of DVM. Although three rotations are strongly encouraged to provide trainees with more time to select a thesis mentor, the flexibility to select a research lab after two rotations is geared towards accommodating those CD trainees who enroll in the program after their first year of DVM training instead of those CD trainees that enroll straight out of college. These research rotations typically are structured as follows:

a.1. First rotation: Veterinary Investigator Program (VIP). VIP is a summer program designed to provide incoming and first- or second-year veterinary students with an intensive research experience, including state-of-the-art experimental methodology. In addition to this hands-on lab training, students also participate in seminars geared toward emerging research techniques, introduction to grant writing, and ethics, and participate in career panel discussions. They also attend and present at the annual National Veterinary Scholars Symposium (NVSS).

a.2. Second rotation: VTMED 6899: Research Projects in Veterinary Medicine. CD trainees enroll in this course in the spring semester of their first year of DVM, and they use the course for their second lab rotation. For this course, trainees work individually on a research project in the lab of a PI involved in biomedical research. Students submit a summary at the end of the semester describing what they accomplished and learned from this research opportunity. In addition to using the course for their second lab rotation, CD trainees can enroll in this course multiple times during their DVM training (with between 0.5-3 credit hours (CH)) for up to a total of 11 CH during their DVM program.

a.3. Third rotation: Leadership Program for Veterinary Students (LP) or Summer Intense Fellowship in Clinical Translational Research for Medical Students (CTSC). LP provides the student with (i) a summer research experience in a basic research environment, (ii) opportunities to develop skills in leadership, communication, critical thinking, and team work; and (iii) a network of contacts useful for future career plans. Similar to the first lab rotation as part of VIP, here students can also attend and present at the annual NVSS. As a newly implemented activity, CD trainees will also be able to opt for CTSC as their third rotation (See letter of support). This summer program is hosted by the Weill Cornell Medicine Clinical & Translational Science Center and provides an introduction to basic and clinical biomedical research for first- and second-year medical students. As part of CTSC, CD trainees will conduct research at Cornell CVM, which is part of the Weill Cornell CTSC consortium, but they will also attend selected events at Weill Cornell with their medical student cohort. Being part of the CTSC program will provide CD trainees with a unique opportunity to be exposed to research and instruction in a human medicine setting. The CTSC program is similar in structure to the VIP program, described above, and one additional slot per year will be made available to a CD trainee through matched institutional support by Cornell (in terms of a \$6,500 summer stipend in summer before DVM year 2; see the Institutional Support Letter).

b. Required Courses

DVM courses: All CD trainees build strong foundational knowledge in biomedicine through the Foundation Courses I, II, III and IV described below, which occur during the first 1.5 years of the DVM program and before they enter the graduate part of their training, while Foundational Course VII is spread through the DVM curriculum.

b.1. DVM Foundation Courses I to IV and VII. Foundation courses are interdisciplinary and represent approximately 70 percent of the DVM curriculum. In Foundation courses I, III, and IV, students work in small groups under the guidance of a faculty tutor on case-based exercises. These exercises are used to facilitate the understanding of basic science concepts within the context of clinical medicine. This tutorial-based educational format creates an atmosphere that requires students to be involved actively in their learning and allows them to develop skills in communication, team work, information retrieval, and analysis. Through this tutorial-based format, students are specifically encouraged to (i) ask empowering questions, (ii) work in group to achieve their goals and foster collaborations with the other group members to create a climate of trust, (iii) develop thoughtful approaches to guide choices in order to improve their critical thinking, and (iv) monitor their own progress by self-motivation and self-evaluation. They are complemented by lectures, laboratories, and discussion sessions or other organized learning opportunities specific to the individual course. Foundation course I handles The Animal Body (VETMED 5100; 12 CH); Foundation course II handles Cell Biology and Genetics (VETMED 5200, 6 CH); Foundation course III handles Function and Dysfunction (VETMED 5300&5310, 9&7 CH); and Foundation course IV handles Host, Agent, and Defense (VETMED 5400, 12 CH). Foundation course VII is divided into 6 sections (a-f). Section a (VETMED 5701; 1.5 CH) teaches physical examinations; section b (VETMED 5702; 1.5 CH) covers topics related to ethics and animal care in the veterinary profession; section c (VETMED 5703; 1 CH) introduces students to medical record keeping and to the communication and leadership skills and techniques necessary for effective communication with clients, professional colleagues, and co-workers; section d (VETMED 5704; 1 CH) further builds on the clinical skills taught in previous sections and also covers communication exercises; section e (VETMED 5705; 1.5 CH) provides an overview of the veterinarian's broad public health role and provide the knowledge and skills necessary to prevent zoonotic diseases, maintain a safe food supply, preserve antimicrobial effectiveness, and promote One Health; and section f (VETMED 5706; 1.5 CH) handles governmental regulation of the veterinary profession, including proper drug usage, extra label drug use (FDA), controlled substances (DEA), environmental issues (EPA), and biosecurity measures.

PhD courses: Required courses during graduate training described below are generally completed in the first two years of PhD. Trainees can enroll in additional elective courses, generally in consultation with their thesis committee, if it is deemed useful for their scientific growth or research project (see Appendix 3: Elective Activities).

b.2. BIOAP 6100: By Scientific Design: Skill Building for a Career in the Life Sciences I. This course is held during the Fall semester for 2 CH and is attended by the trainees during their 1st year of graduate studies. The class is designed to prepare graduate students for a career in the life sciences. Topics for this course include; grant writing, public presentations, design of experiments, interpretation of data, and literature analysis. Assessment – Grant Writing (60%), Public Speaking (20%), Participation (20%).

b.3. BIOAP 7100: By Scientific Design: Skill Building for a Career in the Life Sciences II. This course is held during the Spring semester for 2 CHs and is attended by the trainees during their 1st year of graduate studies. Topics include hypothesis development, scientific design, critical evaluation of literature, and oral defense. The goal of this course is to help trainees master the skills critical for success in the A exam. The major assignments of 7100 are for students to develop (1) an information graphic that presents the hypothesis or model to illustrate the PhD thesis project (30%) (2) an oral presentation (30%), and (2) a poster presentation tailored to the rotation work/laboratory or area of interest (30%). Intermediate assignment exercises will prepare students with tasks designed to assist in the major assignments, scientific skills development such as literature competency, data visualization, oral and written hypothesis development, critical experimental evaluation skills, and overall professionalism and will include class participation and engagement (10%).

b.4. VTBMS 7200: Biomedical and Biological Sciences (BBS) Seminar – Work-in-Progress (WIP). This course is held during both Fall and Spring semesters for 1 CH and is designed to train graduate students in public presentation of scientific data. Specifically, trainees are required to present annually until their last year of graduate studies and have to attend 75% of the BBS WIP. Mentors and the PI and/or co-PIs attend. First-year graduate students present on their rotation projects.

Students beyond the first year coordinate their annual Special Committee meeting shortly after their BBS WIP research presentation and special committee members attend the trainee's seminar.

b.5. BIOMG 7510: Ethical Issues and Professional Responsibilities. This course is held during the Spring semester for 1 CH and is attended by the trainees beyond their 1st year of graduate studies. Ethical issues in research and the professional responsibilities of scientists are discussed based on readings and occasional lectures. The topics cover the NIH requirements for ethical training of graduate students and follow the recommendations of the Office of Research Integrity. Data are included in Training plan, Section 1.2 on Responsible Conduct of Research (RCR Plan) and Appendix 2 describing Training in Rigor and Reproducibility (R&R) and Responsible Conduct of Research (RCR).

b.6. BIOMG 7941: Preparing for the A-exam: Skills development for Scientific Proposal Writing. This newly implemented course is held during the Spring semester for 1 CH and provides graduate students in the life sciences with training in advanced science writing skills, preparing written scientific arguments, and providing constructive review of written material. Enrolled students are in their second (or higher) year of graduate training and in the process of preparing for their qualifying A-exam.

b.7. Instruction in the proper use and care of vertebrate animals & Training in lab Safety: Mandatory courses in laboratory animal handling and care are available through the Cornell Center for Animal Resources and Education (CARE). Before anybody performing experiments in a lab environment can start their research, they are required to take (and successfully pass) the following 3 on-line tutorials: Lab Safety [EHS 2555]; Chemical Waste Disposal [EHS 2716] and Cornell Health and Safety Basics [EHS 2655]. Additional safety courses are required, depending on the type of research, including (but not limited to): Formaldehyde Awareness Training [EHS 2341] and Blood Born Pathogens Training & Refresher Training [EHS 1074 & 1875].

b.8. Course in scientific programming/scripting and/or quantitative approaches. Due to the increasing importance of quantitation and data science in biology and biomedicine, it is vital to equip trainees with the requisite skills. Indeed, most trainees in biomedical sciences require some training in bioinformatics, data management, and data analysis to be able to deal with the large and complex datasets generated by next generation sequencing and other -omics technologies. As such, it is a new requirement of this training program that CD trainees take at least one course, either an upper-level undergraduate or graduate course and for a minimum of 2 CH, in scientific programming/scripting (e.g., R, Python, or SQL) and/or quantitative approaches as it pertains to biomedical research. This is an area of notable strength at Cornell, and there are numerous courses from which trainees can select one that is appropriate for them, in consultation with their advisor and thesis committee. Examples of such courses include, but are not limited to: CS1133 (Short course in Python; 2 CH); BTRY4381 (Biomedical Data Mining and Modeling; 3 CH); ORIE 4820 (Spreadsheet-based Modeling and Data Analysis; 3 CH); BTRY 6010 (Statistics in Biology; 4 CH); BTRY 6830 (Quantitative Genomics; 4 CH); BTRY 6840 (Computational Genetics and Genomics; 4 CH); or STSCI 4140 (Applied Design; 4 CH).

b.9. Foundational graduate courses. In collaboration with their PhD thesis mentor, CD trainees select foundational graduate courses that are most relevant to their thesis research and individual background.

c. Workshops and Seminars

c.1. Participation in journal clubs and seminar series. A variety of training-related activities are sponsored by the College of Veterinary Medicine and other academic units at Cornell. They include the BBS WIP meetings (see above, under a.3), departmental seminars and the BBS Signature seminar series (see below, under b.2), poster presentations, conferences, journal clubs, and special lectures. Some events are organized at the university or college level while others are sponsored by departments, other graduate fields, or individual laboratories. CD trainees are expected to take part in those journal clubs/seminar series, especially when the enrichment activities are relevant to the individual's discipline and thesis research. The MSTP PI and co-PIs will attend the WIP (work-in-progress) seminars, whenever possible, when a CD trainee is presenting and will provide verbal feedback on presentation and scientific communication skills. There are many cross-departmental and cross-college training activities that reflect the diversity of academic pursuits at Cornell, among which CD trainees can choose from. A few are listed below:

a) Annual One Health Symposium. This symposium is organized annually and has opportunities for trainees to present posters. The symposium is jointly supported by the CVM and commercial sponsors, and is open to the general public. Featured speakers in 2021 included Dr. Casey Barton Behravesh, director of the CDC's One Health Office in the National Center for Emerging and Zoonotic Infectious Diseases, and Dr. Bernadette Dunham, professorial lecturer at the Milken Institute of Public Health at George Washington University.

b) Cornell Center for Vertebrate Genomics (CVG). 18 MSTP preceptors (faculty trainers), including both MSTP co-PIs, are members of the Center (Adler, Aguilar-Carreno, August, Brito, Butcher, Cerione, Cheetham, Danko, De Vlaminck, Hu, Kurpios, Lee, Leifer, Rudd, Sethupathy, Van de Walle, Weiss, White, and Wolfner). The center organizes a monthly journal club with topics addressing genomics as well as diversity, equity, and inclusion, in science. It also holds a day-long summer symposium every other year with invited guest speakers (in 2022, external guest speakers were Dr. Kathrin Plath, Professor of Biological Chemistry, University of California; Dr. Nenad Sestan, Professor of Neuroscience, Yale University; Dr. Olufunmilayo Olopade, Associate dean for Global Health, University of Chicago; and Dr. Brenna Henn, Associate Professor of Anthropology, UC Davis)) as well as a poster session for trainees. Moreover, CVG organizes a vertebrate genomics seminar series (VERGE) for faculty and postdoctoral presenters interested in vertebrate genomics, that is of interest to our trainees. Of note is that the CVG allows graduate students to gain leadership experience by serving on the Trainee Executive Committee or as journal club leaders and by hosting the invited guest speakers. In addition, students can get grant writing experience by applying for scholarship funding and to date, two CD trainees have won CVG scholar awards and one CD trainee has been appointed on CVG's T32 training grant in Vertebrate Developmental Genomics.

c) Cross-campus Journal Clubs. These include meetings in Bacterial Genetics, Cell Biology, Cellular and Molecular Neurobiology, Developmental Biology, Ecology and Evolution of Infections and Disease, Environmental Microbiology, Epidemiology, Epigenetics, Eukaryotic Gene Regulation, Molecular Evolution, Neuroethology, Pharmacology, Reproductive Biology, Sexual Selection, Quantitative Genomics, Computational Genomics, and Virology. All are available to our CD trainees.

c.2. BBS Signature seminar series (BBS-cubed) with a trainee-hosted scientist. As part of the BBS signature seminar series, one slot has been reserved for a trainee-hosted speaker. Trainees will host the speaker, meet with them at lunch and dinner, and introduce the speaker at the seminar. The BBS signature series is intended for high profile pre-eminent scientists. We expect that trainees will invite a high caliber scientist who presents an area of general interest to all program trainees.

c.3. COMM 5660 - Science Communication Workshop. Due to the increasing importance of effective science communication, it is a new requirement of this MSTP training grant that CD trainees will attend this 1-CH course that is provided as a weekend workshop. It trains researchers in the sciences to communicate effectively with nonscientists, such as policy makers, political stakeholders, the media, and the general public. Training activities include e.g., role-play, reading/discussion, and writing press releases and other outreach materials.

c.4. Seminar on Team Science. Due to the dramatic increase in the scale and complexity of scientific research, including biomedical research, there is a shift towards "team science", which is defined as a collaborative effort to address a scientific challenge that leverages the strengths and expertise of professionals, oftentimes trained in different fields. However, challenges of collaboration can slow a team's progress in achieving their scientific goals. Professor of Policy Analysis & Management at Cornell, Dr. William Trochim, PhD, MA, will give a seminar with the following or similar title: "More Than the Sum of the Parts: Introduction to the Science of Team Science." Dr. Trochim developed the concept mapping methodology used to "map" the key research issues in the new field of team science. This newly implemented seminar is designed both to introduce the research in an exciting new area of study called the Science of Team Science (SciTS) and to provide resources for trainees and faculty engaged in collaborative research efforts.

c.5. Participation in trimonthly veterinary research career discussions. Every three months, the PI and co-PIs, as well as members of the Executive Committee (as available), will get together for lunch with all of the CD trainees for a discussion of career issues specific to veterinarians. These lunch sessions, unique for CD trainees, will cover following discussion topics that include, but are not limited to: What fellowship options are available for DVM/PhDs; Getting a job in academia and negotiating a start-up package; Differences and overlap between basic science and translational science; Work-life management; etc.

One of these lunch meetings will be devoted annually to a discussion on R&R using the R&R training modules developed by the NIH (see 1.3. Plan for Instruction in Methods for Enhancing Reproducibility). CD trainees will be asked to watch the video prior to the meeting and during the lunch meeting, they will work in small groups to address the discussion questions and then share their ideas with the whole group. These discussion sessions will help trainees develop skills in evaluating scientific premise, designing rigorous experimental methods that consider biological variables and reagent authenticity, as well as in reporting transparency and resource sharing.

c.6. Attending the annual alumni Cornell CD Career Panel. This new initiative will be modeled after the Weill Cornell Medicine's Clinical & Translational Science Center "Alumni Career Panel and Entrepreneurs in Residence Program". Briefly, the CD program will host and financially support an annual event, unique to CD trainees, featuring Cornell CD graduates who have gone on to successful careers in research in academia, industry, or government. In the "Entrepreneurs in Residence Program" part of the event, successful entrepreneurs will be paired as mentors to CD trainees, providing an additional opportunity for fostering the interest of CD trainees in entrepreneurship, as described in Appendix 3: d. Workshops on Entrepreneurship. Similarities between this event and the one by Weill Cornell Medicine's Clinical & Translational Science Center, provide an opportunity to collaborate to which PIs of this grant and the leadership of CTSC are committed (see Letter of support). Thus, this program will also aid CD students' networking.

d. Training Activities

d.1. Annual completion of an Individual Development Plan (IDP). A requirement of the BBS graduate school is the annual completion of the IDP at the start of the fall semester. The IDP is a tool that assists the graduate trainee in identifying areas for scientific and personal development and is developed as a partnership between the trainee and their mentor to plan and communicate.

d.2. Annual BBS Program Graduate Research Symposium and Poster Day. This event is hosted by the CVM. There is a trainee poster session, faculty talks, and a student-invited keynote address. BBS departmental trainees organize the symposium together with a faculty advisor. Recent student-invited keynote speakers include: (2022) Dr. Vincent Racaniello, Columbia University; (2021) Dr. Judy Campisi, The Buck Institute; (2020) Dr. Fernando Pardo Manuel de Villena, The University of North Carolina at Chapel Hill; (2019) Dr. Justin Sonnenburg, Stanford Medicine. Since 2022, graduate students can participate in the newly implemented Three Minute Thesis (3MT) competition, where they present a compelling story on their thesis research and its significance in just three minutes, using language appropriate for a lay audience. The first 3MT competition was won by one of our CD students. The MSTP PD and co-PDs will attend this event, whenever possible, when a CD trainee is presenting a poster and will provide verbal feedback on presentation and scientific communication skills.

d.3. Combined degree (CD)-specific dinner meetings and annual summer retreat. These two required activities are new to the MSTP program and are uniquely designed for CD trainees. Every two months, a dinner meeting will be organized by the MSTP Leadership team to bring together all CD trainees in an informal setting to talk about their challenges and successes in order to encourage and maintain bonding of the CD cohort.

In addition, an annual 1-day summer retreat for CD trainees will be organized by the MSTP Leadership team together with 1 or 2 CD trainee representatives, who will be actively involved in selecting and inviting the external speakers. These retreats can take place in Cornell-owned event spaces, such as the Cornell Lab of Ornithology, ILR Conference Center in King-Shaw Hall, or the Herbert F. Johnson Museum of Art. CD trainees will present on their research, both when in their clinical and PhD years, and one external high-profile clinician scientist will be invited to give a seminar and then interact with the CD trainees during the social breaks. External scientists can include e.g., Cornell alumni such as Dr. Kaori Sakamoto, Associate Professor in the Department of Pathology at the University of Georgia or Dr. Karsten Hueffer, Professor of Microbiology & Associate Dean in the Department of Veterinary Medicine at the University of Alaska. Specific attention will go to inviting veterinary scientists from various backgrounds, including those from underrepresented groups (aimed at enhancing the success and retention of URM CD trainees specifically; see 1.1.2.3. Retention and Support), to talk about various career paths, to provide insights about how a person's background can influence career choices, to talk about work-family balance, etc.

d.4. Cornell MSTP Clinical Specialist Program. This new Cornell MSTP Clinical Specialist Program, which is uniquely designed for CD trainees, provides students with exposure to clinical medicine during the period of their PhD training. Each CD trainee is assigned one clinical mentor, who will work with them for the duration of their PhD training. CD trainees meet with their mentor for one half-day each month during the academic year (September to May) to discuss one veterinary patient after their clinical evaluation. CD trainees will pay special attention in their discussion to (i) knowledge gaps, based on the current state of research regarding the clinical problem, (ii) alternative solutions, and (iii) potential relevance to human health; all in order to stimulate their critical thinking. They are provided with written feedback by their clinical mentor following each semester of the program, where the mentor offers guidance to clinical care/skills that were performed effectively and suggests opportunities for improvement, as well as the effectiveness of their implementation of current research knowledge and description of relevance to human health. Overall, this program will (i) provide exposure to clinical veterinary medicine for CD trainees during research training, (ii) retain their competency in history-taking and physical-examination skills, (iii) incorporate their research knowledge and critical thinking into practice, and (iv) facilitate the transition from graduate school to the last 2.5 clinical, years of Veterinary Medical School. Clinical mentors interested and able to participate in this program include MSTP preceptors: Drs Michelle Delco, Sabine Mann and Heidi Reesink, among others.

Appendix 2: Responsible Conduct of Research Syllabi

Syllabus BioMG7510 Ethical Issues and Professional Responsibilities

The class will feature online recorded lectures and a live online discussion on the topics below. There are two discussion sections on Thursdays (listed as Lec1 and Lec2). Students should sign up for only one lecture and attend only one session per week at the time they have registered.

The class fulfills the requirements by NIH for training in responsible conduct of research. The class is organized by Prof. Maureen Hanson (Molecular Biology and Genetics) but features faculty participants from a variety of departments. Readings required (with some optional) for each lecture will be posted on Canvas. A satisfactory performance requires attendance at all discussion sessions (see exception below) and a score of 70% or above on questions on background reading that will be administered as quizzes. The quizzes will be taken online each week.

While attending all classes is recommended, you may miss two classes for any reason. No need to inform the instructor of the reason for your absences. If more than two absences occur, significant make-up work will be needed no matter what the reason for your extra absence(s). The requirement for 70% correct answers refers to 70% of the questions **asked during those classes you attended**. You will not be penalized for missing questions occurring during classes you did not attend.

The recorded lecture by the faculty shown should be viewed before each week's Thursday discussions.

Lectures by week:

1. RCR at Cornell overview Mark Hurwitz
2. Data management and presentation Carolyn Sevier
3. Determining authorship Maureen Hanson
4. Ethical review of manuscripts Mariana Wolfner (MSTP preceptor)
5. Whistleblowing Brian Crane
6. Ethical citation Maureen Hanson
7. Rigor and reproducibility Erika Mudrak
8. Responsible presentation of science to the lay public Sarah Davidson Evanega
9. Conflicts of interest Laura Bellows
10. Spring break (no class)
11. Peer review of grant proposals Paul Soloway/Maureen Hanson
12. Humans as research subjects Praveen Sethupathy (MSTP preceptor)
13. Gender issues in science Maureen Hanson
14. Animals as research subjects Wendy O. Williams
15. Inventorship vs Authorship Maureen Hanson

Appendix 3: Elective Activities

Preamble

In addition to the required rotations and mandatory training (Appendix 1), CD trainees are encouraged to participate in optional training as it relates to their specific area of research, scientific growth, and/or future career goals and will be **expected to choose at least 5 from among 18 elective activities listed here**. CD trainees, including the MSTP trainees, take this elective training in consultation with their PhD thesis committee and are supported by the MSTP Leadership and CD Oversight Committee.

Similar to the required training activities (Appendix 1), the elective activities described below are geared towards producing well-trained clinician-scientists with skills in six main competency domains: (1) *disciplinary knowledge*, (2) *clinical skills*, (3) *technical skills*, (4) *operational skills*, (5) *professional skills* and (6) self-development skills.

Elective activities are grouped into 4 areas of enhanced training: a. training in technical skills, b. training in professional skills, c. workshop for career development, and d. workshops on entrepreneurship.

Similar to the required training activities, the MSTP training grant offers **5 elective training experiences that are newly implemented, new, and/or uniquely designed for CD trainees** to reach this goal.

a. Training in Technical skills

a.1. Elective courses in scientific programming/scripting and/or quantitative approaches. In addition to the required course in scientific programming/scripting and/or quantitative approaches (see Appendix 1, a.7). CD trainees will be encouraged to consider other statistics courses available at Cornell, e.g., VTPMD 6105 (Biostatistics for Health Sciences, 3 credit hours (CH)), as it pertains to their research. Students with a focus in epidemiology additionally or alternatively can take the core course VTPMD 6660 (Advanced Methods in Epidemiology, 3 CH). Finally, students will be encouraged to take BIOMG 6000 (Genomics, 3 CH), which is a genomics course with incorporation of basic bioinformatics tools.

a.2. ALPHA workshop on machine learning. This is a newly implemented workshop on machine learning in veterinary medicine offered by Dr. Parminder Basran, MSTP Affiliate Preceptor, but without learning how to code. Machine learning has the ability to analyze multidimensional and complex data with increasing importance in early prediction of diseases and identifying risk factors of disease, thus, enabling early treatment and improved animal welfare. It is a 2-day workshop spanning each morning and consists of a mixture of didactics and lectures, combined with a hands-on workshop with simple examples.

b. Training in Professional skills

b.1. LEAD 3100 Foundations in Leadership: Skills for Personal and Professional Effectiveness. This course (3 CH) frames leadership as a particular way of approaching life, one that is essential to both personal fulfillment and career effectiveness, and fits into the objective of this training grant to develop biomedical science leaders. This course includes e.g. developing a critical understanding of contemporary leadership styles and role; building skills for communicating effectively, especially in difficult conversations; and establishing a habit of reflection to promote continuous learning and effective leadership.

b.2. NBA 5150 Leadership Theory and Practice. This course (3 CH) focuses on the challenges of effective leadership in a complex world. It has four significant parts: 1. Exploring historical and contemporary theories and models of leadership through the required text and selected articles; 2. Examining and applying the Cornell's Johnson School's Leadership Model; 3. Analyzing the practical challenges of leadership through case studies, and executive speakers; 4. Developing self-awareness of the student's leadership strengths and weaknesses through the use of behavioral instruments and group exercises and creating a personal action plan for improvement. A critical element of this course is the coaching and feedback students receive on their own leadership styles and behaviors from their peers and instructor.

b.3. INFO 5431 Teams and Technology. This course (3 CH) is designed to provide students with an understanding of research, design, and management of teams whose work and interactions are influenced by technology. Key questions

that are addressed include: How does technology influence teamwork? How do we design technology to support teamwork? How do we build effective teams and team interactions for teams that work face to face or online? The course draws primarily from literature in organizational behavior, social psychology, design and human computer interaction, and group exercises will be used to actively build teamwork and team-leadership skills.

b.4. BBS Student Community Programs. In addition to required training activities (see Appendix 1, c), all graduate students have access to optional programs including a peer-mentor program for first year students, a wellness program (including mental and physical health programs), the BBS graduate student society (sponsors academic and social events for the graduate student community, and which also represents the concerns of the students to the BBS administration), the BBS Diversity and Inclusion Council (assembles resources and hosts events to support students from historically marginalized groups in academia), and the K-12 outreach program (providing opportunities for graduate students to participate in outreach).

b.5. Opportunities to communicate scientific research across disciplines and to the public. There are ample opportunities throughout Cornell University to communicate science across disciplines and to non-scientists e.g., Science on Tap (SoT), Beer with a Scientist/Wine with a Scholar, Lab Crawl, or Three-Minute Thesis (3MT) competitions.

b.6. Opportunities to gain teaching skills and experience. CD trainees interested in a career that involves formal teaching in an academic setting can serve as a teaching assistant for one semester. There are numerous courses students can choose from, but a unique opportunity for CD trainees is to participate in the tutorial-based educational format of one of the Foundation courses, as described under Required Courses (Appendix 1, b.1). CD trainees can also enroll in courses offered through the Cornell Center for Teaching Innovation (CTI) to learn how to integrate innovative pedagogy in the sciences. The course “Theater Techniques for Enhancing Teaching and Public Speaking” (ALS 6014, 1 CH) is a 7-week course offered in the fall. Using theater techniques, it helps graduate students enhance their classroom teaching and public speaking in both formal and informal environments and build the confidence necessary to connect with a variety of audiences in a range of educational settings. The course “The Practice of Teaching in Higher Education” (ALS 6015, 2 CH) is semester long course that is offered in the spring. It assists graduate students in preparing for a faculty position in higher education. Course assignments and activities cover effective teaching and professional development, including faculty roles and responsibilities, educational philosophies, learning theories, instructional methods, and course design.

c. Workshops for Career Development

c.1. Opportunities to participate in the Cornell Careers Beyond Academia program. This program is intended for all graduate students and postdoctoral trainees and provides career advice, training and externship opportunities to enhance trainee prospects of attaining careers outside of academia. This program is available to all CD trainees and is overseen and funded by the Cornell Graduate School. The Director of this program, Dr. Varvanyanis, also runs an annual course in the spring (GRAD9110 - Professional Career Foundations; 1CH) to provide more structured career development resources.

c.2. COHA Clinical and Translational Scientist certificate. A unique and newly implemented aspect for CD trainees is the opportunity to participate in one or more training modules offered through this DVM/PhD support initiative that is an NIH-funded Clinical and Translational Science Award One Health Alliance (COHA) program. The goal of this program is to address gaps in integrating clinician/translational scientist training into the DVM/PhD research training across national programs. There are 3 phases of training that trainees can participate in, in full or only partially, depending on their needs and career stage. These include 1) Veterinary Scientist Professional Development, 2) Integrating Research into the Clinical Years, and 3) Transitioning after the DVM/PhD. The training modules are a mixture of in-person and Zoom meetings and are held anywhere between annually and monthly, to allow for the greatest flexibility. When trainees complete a certain number of modules (5 points), they earn a COHA Clinical and Translational Scientist certificate.

c.3. Burroughs Wellcome Fund (BWF)-sponsored “Becoming Faculty” workshop. The workshop is a short course sponsored by the BWF that focuses on DVM/PhDs launching a scientific career in academia. The workshop is modeled after a similar course run by the Howard Hughes Medical Institute several years ago and is an intense tutorial on “things PIs wish someone had told them before starting a faculty job”. It runs in parallel with the National Veterinary Scholars Symposium (NVSS) (see c.4). Participants are typically nominated, which would be the MSTP Leadership and CD Oversight

Committee for CD trainees. The co-PI of this MSTP training grant, Dr. Van de Walle, has been a facilitator for this workshop for years and will continue to run this workshop when the current organizer retires.

c.4. Attending and presenting at the annual National Veterinary Scholars Symposium (NVSS) and the National Colloquium for Combined DVM-PhD Biomedical Scientists. All CD trainees are encouraged and financially supported to attend the annual National Veterinary Scholars Symposium (NVSS). This 3-day conference highlights the essential role of scientific research in veterinary medicine and provides veterinary students who have conducted original research through summer scholar and other research programs an opportunity to formally present their research in a professional environment. For CD trainees in particular, the first day of the NVSS runs in parallel with the National Colloquium for Combined DVM-PhD Biomedical Scientists. The CD Colloquium aims to develop strong ties between DVM-PhD training programs nationwide and to promote the value of veterinary clinician-scientists. PI Ivanek is a member of a three-faculty Colloquium planning team and was the lead faculty on the planning team for the Colloquium in 2022, with the commitment to actively participate in the planning of the Colloquium in 2023 before rotating out. Also, PI Ivanek is organizing online meetings with directors of other CD programs in the USA to discuss common interests such as recruitment and training.

d. Workshops on Entrepreneurship

d.1. Cornell Hackathons. A hackathon is defined as “the use of minimal resources and maximum brain power to create outside-the-box solutions ("hacks") in a constrained time frame”. Hack + marathon = hackathon. To address the growing interest of clinician-scientists in innovation and entrepreneurship, CD trainees will be encouraged to attend one of these annual weekend-long team events offered at Cornell to foster their creativity, and include both Animal Health and Human Performance Hackathons. For example, the Animal Health Hackathon organized by Cornell CVM is sponsored by various animal health product and service companies, with representatives being present, and is an interdisciplinary event that brings together trainees from across degrees, majors, and schools at Cornell University. There are also faculty mentors present who provide feedback and guidance to the various teams; and the PI Dr Ivanek and co-PI Dr. Van de Walle have served as mentors during these hackathons.

d.2. Participating in training events organized by The Center for Veterinary Business and Entrepreneurship (CVBE). The CVBE leverages the strengths of the Cornell College of Veterinary Medicine, Cornell SC Johnson College of Business, and leaders from across the veterinary ecosystem to solve some of the most pressing challenges facing animal (and human) health and to improve rationally-based decision making and research-based healthcare delivery. The MSTP leadership will collaborate with CVBE on new and unique training activities that can promote the professional skills of our CD trainees, such as leadership and business training.

Plan for Instruction in the Responsible Conduct of Research (RCR)

At Cornell University, there is a comprehensive curriculum in place for education in the Responsible Conduct of Research (RCR) for all NIH-supported trainees. Indeed, Cornell University is committed to promoting and ensuring exemplary research conduct across all disciplines and has established procedures to provide trainees with an educational experience that will instill life-long values of scientific research integrity and ensure compliance with NIH policy. In addition to the NIH requirements, the Cornell RCR curriculum is designed to also meet the regulatory requirements set by NSF and USDA-NIFA for funded research. The comprehensive policies are advertised through the Graduate School web site and are overseen by the [Cornell Office of Research Integrity and Assurance \(ORIA\)](#), which maintains records and ensures compliance of all trainees at Cornell with federal grant RCR requirements. The ORIA website maintains resources and links to information regarding RCR – these include links to the relevant pages on the NIH and Department of Health and Human Services (DHHS) websites.

The Cornell University Combined DVM-PhD Medical Scientist Training Program (MSTP) participates fully in the RCR curriculum, which is as follows:

Year 1: On-Line Responsible Conduct of Research training: Collaborative Institutional Training Initiative (CITI)

Initiated in 2010, Cornell requires all students and post-doctoral researchers supported by NIH-sponsored grants to complete an online RCR foundational training. Cornell has contracted with a third party, CITI, to provide this training program. CITI specializes in training for the research community and is used by many peer institutions for RCR training. Individuals must complete RCR on-line instruction within one month of their appointment to an NIH-funded project. Individuals must complete all online modules with a passing score of 80 or above and the result is permanently recorded on the Collaborative Institutional Training Initiative web site. The modules are:

- (1) Introduction to the Responsible Conduct of Research
- (2) Research Misconduct
- (3) Data Acquisition, Management, Sharing and Ownership
- (4) Data Acquisition, Management, Sharing and Ownership
- (5) Publication Practices and Responsible Authorship
- (6) Peer Review
- (7) Mentor and Trainee Responsibilities
- (8) Conflicts of Interest and Commitment
- (9) Collaborative Research.

If an individual does not successfully complete the training by the due date, the NIH funding source will not be available for their financial support.

Although this online training will provide significant RCR content, NIH policy specifically states that "on-line instruction may be a component of instruction in responsible conduct of research but is not sufficient to meet the NIH requirement for such instruction, except in special or unusual circumstances." In compliance with this policy, our educational program in RCR includes two other required elements, described below.

Year 2: BioMG7510: Ethical Issues and Professional Responsibilities

All trainees on the MSTP are required to complete the mandatory course BIOMG 7510: Ethical Issues and Professional Responsibilities (see Appendix 1. Required Training Activities). This 14-week, 1 credit hour (CH) course is held during the Spring semester and is attended by trainees beyond their 1st year of graduate studies.

The textbook for the course is "On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. The class features lectures and small group discussions on the following topics: ethical citation, secure data management, ethical review of manuscripts, whistleblowing, rigor and reproducibility, authorship determination, responsible presentation to the lay public, conflicts of interest, avoidable errors in publishing, peer review of grant proposals, animals as research subjects, humans as research subjects, and inventorship versus authorship.

The class is organized by Dr. Maureen Hanson (recently elected to the National Academy of Sciences) in the Department of Molecular Biology and Genetics, the home department of 3 of our preceptors (MSTP trainers). Guest lecturers and faculty facilitators are drawn regularly from a wide range of departments across campus, including several that are home departments for faculty trainers on this MSTP, including but not limited to Biomedical Sciences, Molecular Medicine, Food Science, and Microbiology and Immunology. Several MSTP preceptors have participated and/or are participating in this course, including Dr. Sevier (on the topic Data Management and Presentation), Dr. Wolfner (on the topic of Ethical Review of Manuscripts), and Dr. Sethupathy (on the topic of Human Subjects Research). The PI and co-PIs of this MSTP have enthusiastically agreed to serve as a faculty facilitator of at least one of the topical discussion sessions during this course.

Cornell University-sponsored Annual RCR Workshops

Cornell University holds a half-day symposium every year (usually in early spring) that is focused on responsible conduct of research. All trainees in this MSTP program are required to attend. The topics of the last six symposia were: Plagiarism (2022), Conflict of Interest (2021), Ethical Considerations about Genome Editing (2020), Acquisition, Management, and Interpretation of Data (2019), Maintaining Public Trust in Industry-Funded Research (2018), and Rigor and Reproducibility (2017). Symposia typically begin with a presentation by a senior faculty member on the selected topic for that year. Following the presentation, two or three case studies are briefly outlined and trainees and faculty facilitators break into small groups (fewer than 10-15 individuals) to discuss the cases (usually 40-45 minutes). After the small group discussions, the entire group reconvenes and reviews the conclusions in a panel discussion format. MSTP preceptors and affiliate preceptors who have participated in the discussions include: Drs. Aguilar-Carreno, August, Cerione, DeLisa, Leifer, Rudd, Russell, Sethupathy, Sevier, Van de Walle (co-PI), VanderVen and Wolfner. Going forward, the PI (Dr. Ivanek) and the co-PIs (Drs. Cheetham and Van de Walle) of this MSTP will participate in the symposia. In general, the feedback for these symposia from trainees has been very positive, as the cases studied are interesting and relevant. Anyone is welcome to use these materials in their classrooms or labs. The latter supports a progression of understanding RCR and allows these individuals to build and enhance their moderation skills on topics that will undoubtedly include different viewpoints.

Additional Project-specific RCR Training

Trainees who work with vertebrate animals are also required to complete a series of online and formal course modules on animal welfare. These course modules are conducted by Cornell's Center for Animal Research and Education (CARE). CARE is a service and a resource to the AAALAC accredited Cornell research and teaching community. Modules cover the following: (1) investigators' responsibilities under federal and state law; (2) educational services available at the University for ethical practices; (3) ethical and other considerations in the formulation of decisions to use animals in research; (4) techniques to minimize the number of animals used in research; and (5) recognition and alleviation of animal pain, recognition of animal diseases, aseptic surgical techniques, anesthesia, and euthanasia. Trainees must be certified by staff veterinarians to handle animals, and to conduct any surgical or other procedure that may involve pain.

Cornell University also requires additional online training programs for research with human participants. Cornell policy requires that anyone engaging in activities covered by its Human Research Protection Program—that is, anyone conducting or helping with research involving human participants—must have appropriate training to assure that the rights, welfare, and safety of human participants involved are protected. All personnel named on a protocol subject to Institutional Review Board (IRB) review must complete the required training before the protocol can be approved. The training must be renewed at a minimum of every 5 years. Cornell utilizes the human participant training program delivered by CITI.

Trainer/Trainee Compliance

All participating faculty will reiterate and augment key elements of RCR when trainees are performing mentored research in their laboratories. This includes, but is not limited to, discussions as part of the annual completion of an Individual Development Plan (IDP) and feedback after research presentations (e.g., VTBMS 7200: Work-in-progress). Additionally, the "A" exam (PhD qualifying) forms distributed by the Graduate School include a section entitled "Research Compliance Information for Graduate Students." Specifically, "Upon completion of the A Exam—when the student receives approval

from the special committee to conduct independent research—the student is required to certify, in writing, compliance with those regulations and policies specific to their research project.” These regulations include a requirement for training with respect to human participants, animal use, recombinant DNA, genetically modified organisms, radiation, biological agents or toxins, hazardous materials, foreign activities, and copyright policy. Thus, the “A” exam provides another opportunity to reiterate and augment key elements of RCR.

DVM Curriculum

After CD trainees return to the DVM curriculum following completion of their PhD, they participate in a core course VTMED5702 in Block VII, with section 2 (1.5 CH) covering topics related to ethics and animal care in the veterinary profession (See Appendix 1. Required Training Activities). This course consists of lectures, small group discussion sessions, and physical examination laboratories. Lectures average 2 hours each week, covering a variety of topics with ethical dimensions of importance to veterinarians. DVM Students participate in two small group discussion sessions in which they discuss topics of interest and work through provided scenarios. In addition, each student chooses a topic to investigate in depth and writes a research paper. Many informal opportunities arise for ethics discussions when the students are on their clinical rotations assisting faculty and staff managing their cases in the teaching hospital. Throughout their career, veterinarians will be faced with ethical dilemmas daily, especially those centered around the interface between the needs of research, animals and animal caretakers, such as during clinical trials. A faculty led Distribution Course entitled “The Healing Art” supplements the ethics discussions so that DVM students can cope with compassion fatigue, a common mental health issue for veterinarians.

Additional Resources

* Cornell University has both a telephone hotline and a website, called EthicsPoint, through which members of the university community, as well as those outside the university, can report issues regarding ethical concerns anonymously. Reporters can use the website (and a private password) to receive information about their report and any subsequent investigation. Examples of ethical concerns might include financial matters, research matters, environmental health and safety, billing compliance, or campus crime.

* Cornell's ombudsman is an individual who can be consulted confidentially by any person who has delicate issues of concern to them. During the RCR workshops, all trainees are reminded about the role of the ombudsman and others whom they can contact in case of ethical concerns or other sensitive issues.

* Cornell offers the Bovay Program, which runs several activities (e.g., seminar series, workshops, panels) and offers numerous resources to be a catalyst for consideration of social and ethical issues in scientific research. Although the program is primarily focused on engineering, the activities are open to all trainees in the university. Trainees in the MSTP program will be encouraged to participate, especially when Bovay Program activities pertain to life sciences research.

* In addition to formal offerings, as described above, the Graduate School offers multiple resources and activities for learning about responsible conduct of research (RCR) by engaging in discussions about the range of issues and dilemmas that must be navigated to avoid violations and penalties for research misconduct. The Ethics Café, Beer with a Scientist/Wine with a Scholar, and Lab crawl activities include discussion of ethical issues, such as conflicts of interest, collaborations, data management and ownership, mentoring relationships, peer review, authorship and publishing, reporting research misconduct, use of human subjects, and use of animal subjects.

To enhance the goals of responsible conduct of research, Cornell has a written [Code of Academic Integrity](#), and policies concerning academic misconduct, how to address financial conflicts of interest, and conflicts of any other interests and commitment. The university ensures that all research as it is being designed, implemented, and communicated by presentation and publication be conducted with the highest ethical standards. The university web site states that the reputation of an individual researcher or scholar, collaborator and co-authors, and the institution can be harmed (and criminal and financial penalties imposed) when research is not responsibly conducted. The university's goal is that graduate trainees know, and adhere to, the federal, state, and university regulations for research, including required training before research can begin. Such a program sustains a rigorous culture for the responsible conduct of research and will provide me with a solid understanding of ethics.

Plan for Instruction in Methods for Enhancing Reproducibility (R&R)

Independent verification of data is a fundamental principle of scientific research. Most research stands on the shoulders of others in which reproduction of the findings of published studies strengthens the prior evidence. Reproducibility is based on transparency of the scientific endeavor so that the methods and analysis can be replicated. Surveys suggest that well over 50% of research studies cannot be replicated. Science and Nature, among many other journals, and funding agencies like the NIH, are focused on enhancing reproducibility of scientific studies. As much as 85% of grant expenditure may be wasted due to inappropriate study design, failure to adequately address biases, non-publication of studies with disappointing results, and insufficient descriptions of interventions and methods (Freedman et al., 2015). The lack of reproducibility in scientific research has negative impacts on health, lower scientific output efficiency, slower scientific progress, wasted time and money, and erodes the public's trust in scientific research (Chalmers and Glasziou, 2009; Ioannidis et al., 2014).

To improve rigor, reproducibility, and transparency, the NIH issued a notice in 2015 with revised grant application instructions that focused on improving experimental design, authenticating biological and chemical resources, analyzing and interpreting results, and accurately reporting research findings. The American Society for Cell Biology describes three types of reproducibility: 1) direct replication, which are efforts to reproduce a previously observed result by using the same experimental design and conditions as the original study; 2) analytic replication, which aims to reproduce a series of scientific findings through a reanalysis of the original data set; and 3) systemic replication, which is an attempt to reproduce a published finding under different experimental conditions or conceptual replication, where the validity of a phenomenon is evaluated using a different set of experimental conditions or methods. The first two types of replication can be addressed through training and policy modifications.

Research transparency underpins confidence in evidence-based medicine and the teaching faculty in the DVM curriculum at Cornell imbues its students to rely on this principle for their professional careers. CD trainees will continue to be part of the research community after they graduate and to contribute to research literature that underpins evidence-based medicine.

This Combined DVM-PhD Degree (CD) Medical Scientist Training Program (MSTP) provides focused instruction in rigor and reproducibility (R&R) throughout the course of a student's training. This education covers a wide range of topics, including but not limited to scientific premise, designing rigorous methods that consider variables and authentication of biological materials, as well as transparency in reporting and resource sharing. The training is offered in the forms of didactic instruction through required courses, required training workshops, formal and informal guidance by mentoring committees, and opportunities for additional training supported by Cornell.

R&R training in the graduate curriculum

- * The director of graduate studies (DGS) meets with trainees when they start their graduate training to highlight various parts of the program, which always includes the importance of R&R and the various means by which they will receive training in this area.
- * The required BIOMG 7510 course "(Ethical Issues and Professional Responsibilities" (see 1.2. Responsible Conduct of Research and Appendix 1. Required Training Activities) always includes one lecture dedicated to "Rigor and Reproducibility", which relates to experimental design, methodological practice, data interpretation, and resource sharing.
- * Once a CD trainee has identified their thesis lab, his/her mentor becomes an important source of instruction in R&R topics including rigorous experimental design, authentication of materials and reagents, statistical analyses, and data interpretation. Because a high quality of the preceptors (faculty trainers) is critical, their reputation for careful, rigorous, and reproducible work has been given due consideration before they are asked to participate in the MSTP.
- * The graduate thesis committee is in part intended to provide additional feedback and evaluation of the student in terms of R&R during the A-exam (doctoral qualifying exam), every subsequent committee meeting, and the B-exam (thesis defense). They discuss with the trainee any perceived deficiencies or concerns pertaining to R&R in the trainee's research and to include this in their annual progress report that is submitted to the Graduate School.

MSTP-specific R&R training

* All MSTP trainees are required to enroll and participate in the annual Office for Research Integrity and Assurance (ORIA)-sponsored RCR workshops (see Plan for Instruction in Responsible Conduct of Research). In 2017, the main topic was Rigor and Reproducibility (R&R), but even when it is not the main topic, R&R is generally covered at some level, given its pertinence to ethical research conduct.

* *CD trainees, including the MSTP trainees, are required to participate in the trimonthly veterinary research career discussion lunches, which provides an opportunity to discuss career issues specific to veterinarians with the PI and co-PIs, as well as available members of the Executive Committee (see Appendix 1. Required Training Activities). One of these lunch meetings will be devoted annually to a discussion on R&R using the R&R training modules developed by the NIH. CD trainees will be asked to watch the video prior to the meeting and during the lunch meeting, they will work in small groups to address the discussion questions and then share their ideas with the whole group. These discussion sessions will help trainees develop skills in evaluating scientific premise, designing rigorous experimental methods that consider biological variables and reagent authenticity, as well as in reporting transparency and resource sharing.*

In addition, there are several Cornell offices that provide additional resources for R&R, with whom trainees will be actively encouraged to consult, as outlined below.

Additional Institutional Resources for R&R training

* The Office for Research Integrity and Assurance (ORIA) – The ORIA coordinates compliance measures on campus and provides particular oversight on research R&R. ORIA provides guidance, resources and regulations surrounding R&R in grant applications, discussion and teaching materials, and articles and reference materials on the subject of R&R. As described above under MSTP-specific R&R training, ORIA hosts an annual Responsible Conduct of Research (RCR) symposium for all graduate students on campus, which is well-attended by both trainees and faculty. In 2017, the RCR symposium focused on ethical issues regarding R&R in research and promoted discussion of the topic using the case study method. Cornell also hosts a series of R&R-related lectures, workshops and courses throughout the year, particularly related to ethical issues and professional responsibilities, and targeted towards graduate students. Thus, CD trainees will have ample opportunities to develop skills in evaluating scientific premise, designing rigorous experimental methods that consider biological variables and reagent authenticity, as well as in reporting transparency and resource sharing.

* The Cornell Bioinformatics Facility (CBF) – The CBF is a university-wide core facility for computational biology and bioinformatics and part of the Institute of Biotechnology. They offer numerous workshops that provide training and support for the use of bioinformatic tools for large-scale biological data analysis. They also offer consultation for project design and data analysis that includes R&R topics.

* The Cornell Statistical Consulting Unit (CSCU) – The CSCU is a professional service group that aims to strengthen research on campus by assisting scholars with the proper and optimal use of statistical methods in their research. Their services provide statistical expertise to the entire Cornell community through consulting, instruction (workshops, training, instructional materials), and contract services. Their services are available either free (for a consultation) or at a reduced rate (for more in depth analysis) to Cornell faculty and trainees. They offer more than 50 different free workshops in a variety of R&R-related areas. CSCU also offers specialized training suited to a particular program or project, as well as free instructional materials.

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