Graduate Program in Veterinary Medicine (VMED)
Program Goals and Outcomes Assessment

Educational Goals
The mission of the Veterinary Medicine graduate program is to promote science-based research and provide high quality education to develop scientists working to improve the health and well-being of animals and people. Research combines basic sciences and veterinary medicine to create novel translational solutions that are applied to domestic pets, food animals, and wildlife. Inherent to our mission is the advancement of human health through more efficient food production, reduced risk of zoonoses, and improved pet wellness. VMED graduate faculty promote the concept of one medicine, one science such that medical advances are now translated in both directions between animals and humans. All VMED graduate students hold the DVM degree or foreign equivalent. We focus almost exclusively on PhD training, but also offer a M.S. program to train veterinary hospital residents in clinical and translational research. Students can choose from a variety of research emphasis areas, including infectious agent pathogenomics, vaccine and diagnostic reagent development, epidemiology, canine cancer, and ecosystem health. Research programs of VMED faculty address health and disease challenges that impact companion animals and livestock species, and employs comparative biology to integrate new knowledge with human medicine. Within the University of Minnesota system, we are the primary graduate program that unites veterinary medicine with scientific training.

Our program goals are to, (1) prepare independent basic and applied scientists for successful careers in academia, industry, or government; (2) foster development of specific skills including leadership, communication, independent and critical thinking, teaching, interdisciplinary research in collaborative environments, scientific and grant writing, experimental and analytical methods; and (3) contribute to the body of knowledge in basic, translational, and applied sciences in animal health and well-being, and emerging and zoonotic threats. Graduates are positioned to address current and emerging of animal and human health challenges as educators and scientists in academia, industry, or government. We foster career preparedness via development of specific skills including leadership, communication, independent and critical thinking, teaching, interdisciplinary research in collaborative environments, scientific and grant writing, experimental and analytical methods.

Best Practices to Ensure Program Outcomes
Biomedical and health sciences research advances the health of all animal species. Interdisciplinary and basic sciences now inform both veterinary and human medicine, leading to new translational approaches for improving health and wellness. Via their prior training in veterinary medicine, VMED students have a fundamental knowledge of many biological processes that maintain, regulate, and effect health and disease. During their PhD, students develop scientific aptitude and gain technical proficiency in modern scientific methods through mentored but independent thesis research. Graduates possess the critical and analytical thinking skills that will allow them to create and translate new knowledge to
their specific field of interest and to address future challenges impacting animal and human health.

Long term career success will require non-technical competencies. Hence, training in VMED stresses development of:

- understanding the implications of a One Medicine/One Science philosophy
- effective written and oral communication
- the ability to work within teams across disciplinary boundaries
- leadership traits
- professional behavior and ethical conduct of research
- cultural and global perspective for their field of study

**Instilling Skills for Career Success**

The expertise and knowledge necessary to conduct scientifically rigorous research in their chosen area are formed and strengthened throughout the students' tenure in the graduate program. As veterinarians, VMED students enter the program with a basic understanding of the principles of various biological systems that affect health and wellness, such as infectious agents, immunology, genetics, cancer biology, nutrition, and physiology. During their thesis training students gain a deeper and more comprehensive knowledge of the medical disciplines used to diagnose and prevent biochemical, infectious, and genetic diseases, and also to understand how food production systems can be refined to improve production efficiency in a safe and sustainable manner while promoting animal welfare.

Thesis research provides students the opportunity to master techniques and analytical tools that can be applied to their research problem. Students acquire and hone command and understanding of their primary field of investigation primarily by conducting original hypothesis-centered research that generates new knowledge. Students must employ appropriate research design, utilize cutting edge techniques, and apply analytical methods to achieve this goal. The thesis work must create new knowledge, be scientifically rigorous, and suitable for peer-reviewed publication.

Journal clubs further promote understanding of emerging technologies while challenging the student to think critically about data and experimental design outside of their primary area of investigation. To proceed to PhD candidacy, students must pass a preliminary exam in which they demonstrate a strong understanding of their field of study and mastery of related coursework. PhD students write and defend their proposed thesis work, including the technological approaches they'll apply to their specific research problem. Defending the dissertation research requires students to integrate their work into the larger body of knowledge, to assess weaknesses within their study design, and to form new and insightful questions deriving from their datasets.

The importance of excellent written communication skills cannot be underestimated, and are honed through core coursework that employs writing intensive assignments. PhD students must independently develop and write a detailed thesis research proposal that is critiqued by their advisor and thesis committee. In addition, students are strongly
encouraged to participate in our grant writing course (VMED5910) in which they come to understand the qualities of a sound and impactful research proposal while writing an original research or fellowship proposal. Peer review of writing assignments further promotes writing effectiveness and critical thinking. VMED students are expected to compete for extramural fellowships, conference awards, and grants to give them an appreciation of various scientific writing styles and purposes.

Annual seminars assist students to develop the ability to speak effectively and clearly to both disciplinary peers and to audiences with diverse backgrounds. Seminars are presented to graduate program faculty and peers who complete written assessments to improve the student’s speaking mannerisms and use of technology to communicate science. The course coordinator and their primary advisor review the audience comments with the student. First year students, especially non-native speakers, are encouraged to enroll in a Seminar Development and Presentation course (VMED5190) in which they learn effective speaking and how to create and use powerpoint-based slide presentations to communicate scientifically. Finally, students may enroll in the University's highly touted Preparing Future Faculty (PFF) course that teaches them how to be effective communicators in various learner environments. Up to 3 PFF credits can be used toward their degree requirements.

Employers increasingly seek out individuals with exemplary communication and leadership skills who can also work confidently within a group. Several core courses utilize hybrid formats that include team assignments. Students from 3 graduate programs (AnSci, CMB, and VMED) share an ethics course in which student teams consisting of students from each of the programs are assigned case studies to explore, review, and present to the class. There are many activities in which VMED students work collaboratively and demonstrate leadership. Each semester they collectively select, invite, and host a seminar speaker within our collegiate Science Seminar Series.

Students are strongly encouraged to participate in leadership experiences, such as serving as the VMED student representative on the graduate program advisory committee, organizing the monthly VMED student group meetings in which they address program issues and opportunities, and via participation in the University of Minnesota Council of Graduate Students. Graduate students are invited to meet with all external seminar speakers and faculty candidates. Importantly, our current students are actively engaged in hosting and interacting with new applicants who interview at the college and VMED graduate program each winter. Accepting these responsibilities helps the student to be able to organize and prioritize their research, coursework, and external interests accordingly. These experiences also help students develop effective approaches for organizing meetings, engaging all group members, and reflecting critically on all viewpoints or action plans proposed by the group.

Science is increasingly a collaborative effort, bringing together researchers not only with different technical backgrounds but also different cultural backgrounds. Further, the pressure of publishing and competing successfully for grants can be overwhelming, particularly in academic careers. Further, much of the research in the VMED program accesses client-owned animals (rather than purpose-bred research animals) and has a medical focus. It is therefore extremely important that our graduates have a strong ethical
compass. Many of our graduates pursue careers within academia in which they will advise new learners and serve as behavioral role models. In addition to observing their own advisor’s actions, students gain professional perspective through various leadership opportunities noted above. Finally, their required ethics course specifically addresses plagiarism, using client-owned animals, data ownership, publishing standards, animal well-being, and clinical research.

The veterinary and biomedical research workforce is culturally rich and dynamic, largely because all cultures have agricultural systems and many diseases are common to animals and humans across the globe. Nearly 50% of VMED graduate students matriculate from outside the US. Notably, female students outnumber male students, reflecting the gender disequilibrium of current DVM classes in North America. Students gain a cultural proficiency by sharing their own experiences and cultural customs in various forums such as graduate seminars and hosting new graduate program applicants. In addition, the required Ethics course fosters open and respectful discussion and exchange of viewpoints regarding accepted behavior, animal use, and inherent cultural biases related to animal research. VMED students may enroll in courses outside of our graduate program, and this allows them to interact with students from other life sciences graduate programs and to value different experimental approaches. Finally, incoming students are matched with a more senior VMED student who serves as an informal resource for information and advice during the first year of study.

The graduate program and the college invest funds that allow students to attend national and international meetings and workshops that they may not normally have the opportunity to experience. This is an important learning mechanism for them in that they discover that a different audience may have quite new perspectives on their work. It also promotes the students’ ability to communicate with various audiences and to consider alternate technical approaches that might employ in their thesis research. Importantly, students gain a bigger view of how their work can be translated into a medical program or to advance a given food industry sector. Together these experiences help broaden a student’s cultural aptitude and global perspective of their field of study. It also educates students on agricultural challenges unique to various populations or nations, and broadens their ability to consider different approaches to address various problems.

Assessing Program Success
VMED uses a number of processes to monitor student progress in the program, well-being, and success upon graduation. All students file an annual report of activities and completed coursework that also includes a statement of goals for the coming year. Students must meet at least annually with their thesis committee to review research progress and to address any areas for improvement in their core knowledge, technical aptitude, and professional development. As stated above, all students present an annual seminar to program faculty and peers. This provides an opportunity to gauge their intellectual growth as well as their research productivity. Prior to ascending to PhD candidacy, students must pass both a written and oral preliminary examination in which they must demonstrate sufficient core knowledge, an ability to communicate their project and experimental aims, an
understanding of the techniques used in their research, and the importance of their work to the field of study.

The VMED program promotes that the numbers and types of awards our students receive to be primary measures of program and student success. Toward this end, a VMED student recently (2013) earned the Distinguished MS Thesis Award at the entire University. Historically, VMED nominees have a much higher than average success rate for Graduate School Doctoral Dissertation Awards, and current students have merited prestigious and highly competitive external fellowships from agencies such as NIFA, the NIH, the Center of Excellence for Emerging and Zoonotic Animal Diseases, and the Morris Animal Foundation. Students present regularly at national conferences and regularly earn “Best Presentation” recognitions. Information on current VMED students, including honors, awards, and thesis-related publications, is located at http://www.cvm.umn.edu/students/ms-phd/VMED/VMstudents/index.htm. Together, these data indicate that their training is sound and that their thesis work is rigorous and impactful.

Post-graduation career trajectories can be difficult to track, but the CVM has long maintained its own alumni database in which we track (as we can) changes in our graduates’ careers or employment. Information on recent graduates, including awards and honors, can be viewed at http://www.cvm.umn.edu/gradprog/programs/vmgp/vmedalum/home.html. Importantly, the CVM Graduate Programs Coordinator conducts an exit interview with all departing students whether or not they have successfully completed the requirements for the degree. This helps us identify potential shortcomings in the program as well as establishing where students matriculate immediately post-graduation. To help us stay connected to our graduates, we issue an electronic quarterly alumni newsletter in which we encourage graduates to share their career news. We maintain an alumni database that we update as alumni change employers in order to assess long term benefits of their VMED education.