May 15, 2019

To: Sarah Mangelsdorf, Provost
    William Karpus, Dean, Graduate School

From: Mark D. Markel, Dean

Re: Ten-Year Comparative Biomedical Sciences Graduate Program Review

Attached, please find the Comparative Biomedical Sciences Graduate Program self-study, the review committee’s report, and the program’s response to the review. The School of Veterinary Medicine’s Academic Planning Council met on May 15, 2019 to review the materials described above. The Comparative Biomedical Sciences Graduate Program was deemed to have many strengths including solid leadership, flexibility in the program requirements to better accommodate the needs of a student body with diverse backgrounds including post-professional degree students, a breadth of research that ranges from clinical aspects of human and veterinary medicine to cellular and molecular mechanisms of disease, and a program that fills a distinct and critical niche in the training of students that addresses the link and overlap in human and animal medicine.

The review committee highlighted three areas it felt the program should address. These included uneven administration of the Preliminary Exam A, the desire to potentially have more students entering the program through rotations, and enhancing the cohesiveness of the student body. The Academic Planning Council and I felt that the response to these concerns addressed by CBMS Director M. Suresh were appropriate. These included that the program will provide greater clarity in the administration of Preliminary Exam A by revising the description of Preliminary A in the program handbook to explicitly state the objectives of the exam and the timelines for the administration of the exam. They will also provide examples of questions drawn from recent examinations. They plan to communicate directly with trainers and students regarding these recommendations. With regard to laboratory rotations, the program has begun offering rotations to highly competitive students and also underrepresented minorities to enhance the program’s recruitment efforts. Because the program does not have funds from TA’s, RA’s, or other positions, to support students that are unsuccessful in finding a laboratory following rotations, there is a limited ability to offer rotations in the program. The majority of students are admitted through direct admission and this is deemed to be a successful pathway for the program and for the program’s graduate students.
One of the great strengths of the CBMS Graduate Program is its flexibility, breadth, and scientific diversity but it does make student cohesiveness a challenge. M. Suresh’s response to this potential weakness is that all graduate students are required to enroll in the 9.30 seminar class with attendance of 70% of the seminars mandatory. The program felt that this was an opportunity to enhance the cohesiveness of graduate students in the program. There are also other courses that many of the students ultimately enroll in, including Research Ethics, BioStatistics, Science Communication and Pathology for Biomedical Students, enhancing the cohesiveness of the program. The program also has an annual fall cookout, holiday bowling event, and I host a monthly get-togethers for all of our faculty, staff, and students to hopefully enhance the cohesiveness of our graduate students.

The Academic Planning Council and I felt that the strategies highlighted by M. Suresh’s letter and response to the review committee report were appropriate and should be implemented. If you have any questions regarding these materials or my response, please do not hesitate to let me know.

CC: Jocelyn Millner, M. Suress, Chuck Czuprynski
Activities and Materials Reviewed by the Review Committee

The Comparative Biomedical Sciences (CBMS) graduate program is administratively housed in the School of Veterinary Medicine. The program currently has 59 graduate students enrolled, of which 45 are pursuing a Ph.D. and 14 are pursuing a M.S. degree. The program emphasizes training in interdisciplinary research in core areas of animal and human health, immunology, molecular and cellular biology, neuroscience, genomics, oncology, virology, infectious disease, toxicology, and pharmacology. The program has a diverse student composition; 12% of domestic students are underrepresented minorities and approximately 36% are international students. In addition, the program has a number of students that already hold a medical degree (DVM, MD) and are adding a Ph.D. or M.S. to expand their experience and knowledge of basic and translational research. Of the students that start on a path to a Ph.D. degree, ≥75% complete the degree and 13% end with a M.S. degree. The CBMS graduate program is consistently ranked in the top 10 programs for veterinary medical sciences by the Academic Analytics Database.

The review team was comprised of committee chair Tom Crenshaw (Professor, Animal Sciences), Joe Dillard (Professor, Medical Microbiology and Immunology), Chuck Kaspar (Professor, Bacteriology), and Steffen Lempp (Professor, Mathematics, Graduate Faculty Executive Committee representative). In addition to review of the self-study document, the committee met with and discussed the operation, goals, strengths, and weaknesses of CBMS with the following stakeholders: program director\(^1\), program coordinator\(^2\), program steering committee\(^3\), students\(^4\), and trainers\(^5\).

Based on the self-study and discussions, the committee found that CBMS is functioning well and serves the needs of a diverse group of Graduate Students with a range of experiences and background. Highlighted below are the strengths, weaknesses, and recommendations for CBMS.

The program has implemented several changes in response to the last review. Changes included a reduction in the number of didactic credit requirements and a system to monitor student progress. These changes have been apparently well received as no concerns in these areas were identified in our review. Graduate committees and students have more flexibility in designing credits based on student career interests. Students are using Individual Development
Plans as they interact with their mentor and committee members. The process to provide lab rotations for new recruits is established. The number of students offered rotations is limited by funds to support the rotations.

**Strengths and Weaknesses of the Program**

A strength of the CBMS program is that it has solid leadership that is committed to the success and improvement of the program. In addition, the program is supported by nearly 100 trainers from across campus that are committed to the operation, administration, and training of students. Another strength identified by both the Review Committee and trainers in CBMS is the flexibility in program requirements. For example, there are no core courses, rotations, or teaching requirements for the program. This contributes to a time-to-graduation for a Ph.D. of less than 5 years. The lack of core courses accommodates the breadth of research and trainers in the program which enables students to focus on courses specific to their area of research. The absence of a teaching requirement does not preclude students from participating in teaching or participation in the Delta program, Teaching Academy, and other opportunities to develop teaching and speaking skills. This flexibility also accommodates the needs of a student body with diverse backgrounds including post-professional degree students.

Another strength of CBMS is the breadth of research covered by trainers that ranges from clinical aspects of human and veterinary medicine to cellular and molecular mechanisms of disease. This makes the program attractive to students with diverse backgrounds and research interests and fills a distinct and critical niche in the training of students that address the link and overlap in human and animal medicine. This also fosters a multidisciplinary approach and collaborative studies to address contemporary problems in biomedical sciences.

A weakness identified by both current CBMS students and some trainers was an acknowledged that the Prelim A is administered in a rather uneven fashion. Some students get a week to answer five written and reasonable questions, one from each of their five committee members. Others, however, either get questions that are far too hard or time-consuming, or get only 24 hours to answer a question, contrary to the rules stated in the Handbook. This leads to students being confused and experiencing an increased anxiety about the Prelim A. The disparity has led to delays in students taking Prelim A by up to three years.

**Recommendations for Future Directions**

**Preliminary Exam A.**
The reason for the uneven administration of the Prelim A seems to lie mainly in advisors or committee members not being familiar with the program rules, or the expectations of what reasonable questions should be. We recommend that the program establish a database of Prelim A example questions from the past five years or so. This database is not intended for questions to be repeated as the fields change too quickly and are too diverse, but simply to serve as a yardstick to guide advisors and other committee members as to what reasonable questions should look like. The examples will also give students a better idea of what to expect
and decrease anxiety about the Prelim A. Our committee agreed with the majority of trainers we met that the Prelim A has a useful function in requiring students to prepare for a more comprehensive test than just exams on individual courses. Provisions of a database of example questions will also give students guidelines on what coursework they might need to take before undertaking Prelim A.

The current CBMS Handbook provides a comprehensive guide for students and trainers. Continue to encourage both students and trainers to refer to the handbook throughout their program.

**Rotations.**
Many students would like several choices for whom to do their graduate work with and the opportunity to work in a lab for a short period of time before committing to do their graduate work there. Thus, highly competitive students are more likely to choose a program that allows rotations. Several CBMS faculty and students suggested that rotations would be desirable for the program. Current total costs for the Sept-Dec typical rotation period are approximately $16,000 per student. Funds contributed by the four core departments plus GSSC funds could be pooled to provide for increased rotation possibilities for incoming students.

**Cohesiveness.**
The CBMS program prides itself on flexibility, allowing students to tailor their courses to their interests and those classes most appropriate to their research topic. However, that also means that the students will usually not be in courses with other CBMS students. Since most CBMS students are directly admitted by their advisors, and labs are located in departments dispersed across campus, students may rarely interact with each other. With so little interaction, CBMS graduate students are unlikely to form a cohort of graduate students able to support and advise each other as is often seen in closely-knit programs.

Several methods might be employed to increase cohesiveness of the program. These include: common classes, CBMS program events, committee work, and social events. As many of the students are required to take an ethics class, new incoming students could be assigned to take the same ethics class. Alternatively, a class that covers material useful to all CBMS students could be created and required. Having all the new students together in the same class their first year is an effective method in forming a cohesive group. Other events related to the program can also be effective. An orientation session for a day or more at the beginning of the year can place the students together, and lunch or a post-orientation social event can help students get acquainted. Other social events, such as retreats, picnics, or holiday parties, during the year should also be considered. Having CBMS committees made up of students will also bring them together. Such committees might perform functions for recruiting, social events, or for bringing in a student-invited speaker.

Overall, we agree with the Self-Study analysis, “the CBMS program is in an excellent state and possesses multiple strengths”
The Review Committee met with the following groups: program director\textsuperscript{1}, program coordinator\textsuperscript{2}, program steering committee\textsuperscript{3}, students\textsuperscript{4}, and trainers\textsuperscript{5}.

1. Suresh Marulasiddappa, chair CBMS Steering Committee
2. Susan Thideman, graduate coordinator

3. Steering Committee:
   - Jyoti Watters
   - Adel Talaat
   - Joan Jorgensen
   - Peter Muir
   - Shannon Walsh
   - Ros Luethcke
   - Lauren Trepanier

4. Participating Graduate students:
   - Aishwarya Bhasker
   - Charlotte Mintie
   - Ros Luethcke
   - Shannon Walsh
   - Hazem Abdelaal
   - Fernando Moreira
   - Brian Su
   - Jordan Mandli

5. Participating trainers (March 22):
   - Mostafa Zamanian – SVM – Pathobiological Sciences
   - Randy Kimple – Human Oncology
   - Charles Czuprynski – SVM - Pathobiological Sciences
   - Sebastian Bednarek - Biochemistry
   - Ed Chapman - Neuroscience
   - Kristen Bernard - SVM - Pathobiological Sciences
   - Matt Reynolds - SVM - Pathobiological Sciences
   - Vijay Setaluri, Dermatology
   - Corinne Henak, Department of Mechanical Engineering
Response to Comparative Biomedical Sciences Graduate Program Review Committee Report
(Prepared by CBMS Director M. Suresh in consultation with Dr. Czuprynski)

Overview: We were very pleased to see the review committee reach the overall conclusion that the CBMS program is in an excellent state. The committee identified several strengths of the CBMS graduate program. These included:

1. Solid leadership
2. Flexibility in the program requirements that accommodates the needs of a student body with diverse backgrounds including post-professional degree students.
3. Breadth of research that ranges from clinical aspects of human and veterinary medicine to cellular and molecular mechanisms of disease.
4. CBMS program fills a distinct and critical niche in the training of students that address the link and overlap in human and animal medicine.

The committee concurred with the majority of trainers that the Preliminary Exam A served a useful function to assess the breadth of student knowledge, beyond exams administered in courses, and as an opportunity for students to integrate information. However, the committee noted as a weakness that the Preliminary Exam A was administered in an uneven fashion. There is some confusion due to lack of clarity about the nature of questions to be asked, and the time allowed for students to provide the answers. The committee opined that these issues not only caused confusion about the exam preparation but also increased student anxiety.

Below are the responses to committee recommendations for future directions.

Preliminary Exam A: The committee reiterated that the reason underlying the uneven administration of Prelim A was linked to the advisors and committee members’ lack of familiarity with program rules and understanding of what reasonable questions ought to be. To mitigate the afore-mentioned issues, the committee suggested that the program establish a database of Prelim A questions from the past 5 years.

Response: We agree with the committee that greater clarity in administration of Preliminary Exam A would be helpful for committee members to frame questions and students to prepare for exams with less anxiety. We will revise the description of Prelim A in the program handbook to explicitly state the objectives of the exam and the timelines for administration of the exam. We also will provide examples of questions drawn from recent exams. Additionally, we will directly communicate the updated information on Preliminary Exam A with trainers and students.

Laboratory Rotations: The committee suggested increased rotation possibilities for incoming students to enhance recruitment of highly competitive students and also allow students to obtain sufficient information before committing to a laboratory. The committee also opined that funds contributed by four major departments along with the GSSC funds could be used to support student rotations.
Response: We agree with the committee that increasing rotations will enhance recruitment of highly competitive students and provide flexibility for students in choosing a laboratory for their research. Beginning this year, we have offered rotations to highly competitive students and also underrepresented minorities to enhance our recruitment effort. However, the CBMS program is limited in the number of rotations that can be offered because we do not have funds (TAs, RAs, etc.) to support students that are unsuccessful in finding a lab following rotations. It should also be noted that historically the CBMS program has been a direct admit program. This approach has served students and trainers well in reducing the time to degree and recruiting highly focused students into the laboratories of their choice.

Cohesiveness: Given the flexibility, breadth and scientific diversity of the CBMS program, establishing student cohesiveness is a significant challenge. Additionally, dispersion of labs across the campus limits interactions between students. The committee suggested several methods to increase student cohesiveness including common classes, CBMS program events, committee work and social events.

Response: We concur with the committee that establishing student cohesiveness is a challenge for the CBMS program. The CBMS program requires all graduate students to enroll in the 930 seminar class (MS: 2 semesters; PhD: 4 semesters). Attendance at 70% of seminars is mandatory and students are required to provide feedback to their fellow students. This class is aimed to enhance the communication abilities of students, expose students to the diversity of research topics in the program, promote cross-fertilization across labs, and foster cohesiveness among students. In agreement with the committee’s recommendations, we offer incoming students a list of highly recommended courses in research ethics, biostatistics, science communication and pathology for biomedical scientists. Additionally, CBMS and the SVM host periodic social events such as Fall Cook-out, Holiday bowling and Dean’s monthly get-togethers. Further, SVM hosts a research day in spring semester to integrate and showcase the research activities of graduate students, DVM students, residents and clinical fellows.

We thank the review team for the time and effort they committed to review of the CBMS program. We appreciate their suggestions they made and will integrate them into the program as described above.
Comparative Biomedical Sciences Graduate Degree Program

Self-Study Program Review

September 2018
Overview

The Comparative Biomedical Sciences (CBMS) graduate program emphasizes training graduate students in a multidisciplinary approach to addressing contemporary problems in biomedical sciences related to animal and human health. Faculty provide exceptional graduate and undergraduate interdisciplinary research training opportunities in core areas of animal and human health including immunology, molecular and cellular biology, physiology, neuroscience, genomics, oncology, virology, medical technology, infectious diseases, toxicology and pharmacology. CBMS trainers also contribute extensive public services, both nationally and internationally, within related faculty disciplines. The graduate program serves as the graduate research training entity in the School of Veterinary Medicine (SVM) and is administered by the Department of Pathobiological Sciences. Trainers in CBMS have their tenure homes in all four departments of the SVM, as well as the College of Agricultural and Life Sciences (CALS), the School of Medicine and Public Health (SMPH), the College of Engineering, and the College of Letters & Science. Faculty in the CBMS program also participate in, or interface with, other campus training programs, including Bacteriology, Biocore, Cellular and Molecular Biology, Clinical Investigation, Endocrinology and Reproductive Physiology, Medical Microbiology and Immunology, Molecular and Environmental Toxicology, Neurosciences and the Primate Center.

The Academic Committee of the CBMS program is responsible for coordination and administration of the CBMS program, screening of faculty trainer applications, student admissions, and certification of students’ programs. The Academic Committee is currently comprised of 11 voting members; two members from each of the four departments of the SVM, a member-at-large from outside the SVM, as well as the 2 student representatives.

Historically, this program (formerly Veterinary Science) has played a highly visible and prominent role in training veterinary and biomedical researchers since its inception in 1911. Graduates include current or recent Deans of Veterinary Schools, members of the USDA Hall of Fame, National Academy of Science members, as well as many leaders in industry and academia and recently, a Nobel Laureate (Dr. Campbell). Graduate students in the program acquire the theoretical background and critical thinking, problem solving and contemporary laboratory skills needed to assume leadership roles in biomedical and veterinary research in academia, government and industry.

The CBMS program currently has a total of 59 graduate students, of which 45 are pursuing the PhD and 14 are pursuing an MS degree. In addition to training scientists in contemporary biomedical research, our program plays a critical role in training veterinary medical scientists to engage in research included in the NIH’s One Health model. One of the strengths of the CBMS program is the diverse student pool; 12% of domestic students are underrepresented minorities and approximately 36% of currently enrolled students are international students. Many of our international students have an infectious disease focus and come with first-hand experience with the disease of interest. These students also provide us with input into international research and policies, as many very quickly attain positions of influence in their home countries upon completion of training. We also attract a significant number of students...
who already hold a medical degree (DVM, MD) and are looking to add a PhD or MS to strengthen their knowledge of basic or translational research.

The CBMS graduate program is consistently ranked nationally in the top 10 for veterinary medical sciences according to the Academic Analytics Database. The database compiles information in categories such as grant dollars awarded, number of books or articles published by faculty/trainees, and number of faculty and trainees with awards or honors. The goal is to provide clear, unbiased information that each graduate program can use for easy comparison at a discipline-by-discipline level as well as overall university performance. “This is a distinction the program has received for many consecutive years,” says Dean Mark D. Markel, “and it’s one sign among many that we have some of the most talented faculty, staff, and students in the field working to understand and address the most significant challenges facing animal and human health.” One of 51 programs nationwide in the veterinary medical sciences discipline, the following graphic depicts the strengths of the CBMS graduate program, according to metrics gathered by Academic Analytics. The inner, dotted circle marks the 50th percentile for the performance of all graduate programs in the 26 categories listed around the perimeter. The colored “petals” depict the CBMS program’s performance.
Graduate training in the CBMS program range from clinical aspects of human or veterinary medicine to research that focuses on the cellular and molecular mechanisms of health and disease. The NIH has emphasized the need for veterinary medical scientists trained in research to advance the concept and practice of the One Health model, and the focus of biomedical research training provided by our mentors emphasizes this link between human and animal medicine. Therefore, the CBMS graduate program fits a distinct and critically important niche within biological science graduate programs on campus and across the country.
Self-Study for Comparative Biomedical Sciences – PhD and MS

Date submitted: September 6, 2018

Primary Contact: Dr. M. Suresh, suresh.marulasiddappa@wisc.edu 265-9791

Department(s)/Academic Unit(s): Pathobiological Sciences

School(s)/College(s): School of Veterinary Medicine

A. **Response to previous program review recommendations**

    *Summarize recommendations from the previous program review and how they were acted upon.*

**Reduction in coursework requirement** - Following the strong recommendation from the 2009 Ten Year Review of the CBMS program, the Academic Committee successfully petitioned the Graduate School to reduce the total number of didactic credits required for the PhD degree from 25 to 20; the requirement for the MS degree remained at 9 credits. Incoming students consult with their advisor and thesis committee to select didactic courses that best support their individual training and research. This provides flexibility to obtain a multi-disciplinary experience in which students design their own curriculum, obtaining the required number of credits as defined by both the Graduate School and the CBMS program. The Academic Committee reviews and certifies proposed programs of study to ensure that the courses meet Graduate School and CBMS program requirements. The reduction in didactic credits improved our ability to compete for the top student candidates and reduced the time to completion of the degree. It is emphasized to PhD students that 20 didactic credits is the minimum requirement for the program. A student’s committee may recommend or require additional didactic course credits if they feel it is important for development of the student and their thesis research program. Furthermore, the option to complete a formal minor is still available to PhD students. Many CBMS students, especially those interested in pursuing clinical/translational research or performing clinical trials, have obtained a minor in Clinical Investigation.

**Better monitoring of student progress** – CBMS implemented use of the program *Filemaker* to track student progress. In the past few years, those data were converted into an excel spreadsheet for continued monitoring. We have discussed using in-house resources to create a new database that will incorporate additional information routinely needed for various reports, including NIH grant renewals, Graduate School competitions, student assessment and SciMed GRS reporting. We believe that better student monitoring has helped contribute to the reduced time to degree. This will be discussed further in report section G - *Degree Completion and Time to Degree.*
Greater funding for lab rotations to attract highest quality students – Laboratory rotations are typically offered to recruits that are interested in more than one lab and to those whom the CBMS Academic Committee is highly confident will find a lab at the end of their rotation. Rotation funds are also used to assist a newly admitted student or those changing labs due to irreconcilable difference between the student and their mentor. We used financial support provided by Biological Sciences Fellowship Funds to admit two students for rotations in fall 2015 and one student in fall 2016. The second student is also an underrepresented minority, former LSAMP scholar and BOPS participant. We offered a rotation to one student admitted in fall 2018, but he declined our offer. Given the nature of the CBMS program, which is highly interdisciplinary and relatively small compared with some other programs in the biosciences, we are limited in the number of rotations we are able to offer. An issue that tends to mitigate against offering many rotations is finding a sufficient number of faculty who are accepting students in a given year compared with students seeking mentors in a specific research area. We strive to avoid the possibility that a student might not be able to find a mentor at the end of a rotation period, resulting in them withdrawing from the program. The SVM is currently exploring ways to guarantee funding and to offer rotations to admitted students in their laboratories of choice.

Periodic assessment of faculty trainers and participation – Criteria for obtaining trainer status include evidence of grants to support potential students, quality of the research program and its relevance to the mission of CBMS, as well as prior experience with mentoring students. Trainers are initially screened and approved by the CBMS Academic Committee. Following the most recent Graduate School exit surveys, the Academic Committee has made it a priority to increase assessment and mentoring of faculty trainers. This includes developing a specific handbook for all new trainers that includes trainer expectations, student requirements, program expectations, recommended diversity and inclusion practices, and the trainer review process. CBMS is developing web-based modules to provide trainers with mentoring training. CBMS trainers are reviewed by the Graduate Program Director, initially 3 years after joining the program and every five years thereafter. At this time trainers will be evaluated for their current work, funding, and evidence of participation in the training program.

B. Overview of the Program

Describe the mission and goals of the program and how its structure (both of the program and of its governance) support them. Consider the following questions:

- Provide current degree/major requirements as approved.

CBMS is an MS/PhD program that emphasizes basic and translational research. The students follow a flexible curriculum developed specifically to support the student’s area of research, providing both a breadth of knowledge in biomedical science and a depth of knowledge in their area of research. The combination of coursework and research experience enables students to obtain a solid foundation in contemporary biomedical research that is tailored to the specific needs of the individual student.
For the MS degree - 30 credits total (combination of didactic or lab courses, seminars and research), one-half of which must be designated as graduate level and taken at UW-Madison. Minimum requirements include:

- 9 credits of didactic coursework is required. Courses can be chosen from the recommended course list in the handbook or based on recommendations of the student’s graduate committee. Six credits of advanced coursework from other institutions, and in rare cases, UW-Madison Special Student or UW-Madison Undergraduate courses may partially fulfill program requirements as approved by the thesis committee and the CBMS Academic Committee, provided they are defined as graduate level.
- 2 credits of Path-Bio 930 – Advance Research Seminar. Must present 1 seminar.
- Research credits, enrolled with their advisor and through their home department.
- Traditional thesis or a substantial scientific paper.

For the PhD degree - 51 credits total (combination of didactic or lab courses, seminars and research), one-half of which must be designated as graduate level and taken at UW-Madison. Minimum requirements include:

- 20 credits of didactic coursework are required. Courses may be chosen from the recommended course list in the handbook or based on recommendations of the student’s research committee. CBMS program strongly recommends a class in responsible conduct of research offered by CBMS trainers Drs. Bjorling and Czuprynski. Nine credits of advanced coursework, or MS/DVM coursework or equivalent from other institutions or UW-Madison Special Student courses may partially fulfill program requirements as approved by the thesis committee and the CBMS Academic Committee, provided the courses are defined as graduate level. In rare cases, 7 credits of UW-Madison Undergrad credits may partially fulfill program requirements with approval by the Academic Committee.
- 4 credits of Path-Bio 930 – Advance Research Seminar. Must present 2 seminars.
- Research credits, enrolled with their advisor and through their home department.
- Prelim A – assess the breadth and depth of knowledge and comprehension of more advanced topics.
- Prelim B - assess ability to conceive a research project and write a persuasive grant proposal related to their research and defend it with the thesis committee.
- Completed dissertation composed of original research work approved by the major professor and the thesis committee, defended before the committee and deposited with the Graduate School.

- How does the mission of the program fit with the home department/unit, the school/college, and the mission of the university?

The CBMS Graduate Program, originally established as the Veterinary Science Graduate Program in 1911, provides students with multi-disciplinary training in the broad area of biomedical sciences related to animal and human health. The program’s philosophy is to provide a challenging, dynamic, collaborative and inclusive environment in which students receive cutting-edge training in their respective areas, achieve their highest intellectual and research potential and in which each individual is valued. The overarching goal of the CBMS
program is to develop future leaders in science and the global community by providing exceptional and well-rounded training in research, written and oral communication, and ethics.

Our program fulfills an important and distinct niche by providing an inter-disciplinary and diverse learning environment for graduate students with interests in scientific inquiry related to: (1) the mechanisms underlying both health and disease in veterinary and human medicine; (2) global health, disease ecology, vector-borne diseases and diseases of wildlife; (3) neuroscience; (4) oncology; (5) biomedical engineering; (6) regenerative medicine; and (7) developmental biology. By doing so, the CBMS program reinforces the SVM’s mission, which is dedicated to providing excellent programs that enhance veterinary medical education, research, clinical service, improve the health and welfare of animals and people, and strengthen Wisconsin’s economic vitality. The CBMS program further supports the University of Wisconsin–Madison’s primary purpose to provide a learning environment in which faculty, staff and students can discover, examine critically, preserve and transmit the knowledge, wisdom and values that will help ensure the survival of this and future generations and improve the quality of life for all. The university seeks to help students develop an understanding and appreciation for the complex cultural and physical worlds in which they live and to realize their highest potential of intellectual, physical and human development.

- What are the approved learning goals for each of the programs being reviewed (i.e. bachelors, masters or doctoral degrees?)

**Master’s Level Learning Goals**
All UW-Madison students entering the CBMS graduate program must hold at least a bachelor’s degree. Graduates obtaining a master’s degree are expected to achieve the following learning goals by the end of their degree work.

- Articulates, critiques, or elaborates the theories, research methods, and approaches to inquiry and/or schools of practice in the field of study.
- Articulates sources and assembles evidence pertaining to questions or challenges in the field of study.
- Assesses and/or applies methodologies and practices in the field of study.
- Articulates challenges involved in practicing the field of study, elucidates its leading edges, and delineates its current limits with respect to theory, knowledge, and/or practice.
- Appreciates the implication of the primary field of study in terms of challenges, trends, and developments in a broader scientific context.
- Demonstrates abilities to apply knowledge through critical thinking, inquiry, and analysis to solve problems, engage in scholarly work, and/or produce creative products.
- Evaluates, assesses or refines information resources or an information base within the field.
- Communicates clearly in styles appropriate to the field of study.
- Recognizes and applies ethical conduct and adheres to professional guidelines.
**Doctoral Level Learning Goals**
Regardless of whether an individual is initially awarded a master’s degree, the doctoral level learning goals are inclusive of the master’s level learning goals. Additionally, doctoral level students are expected to achieve the following learning goals by the end of their degree work.

- Initiates, assembles, arranges and/or reformulates ideas, concepts, designs, and/or techniques in carrying out a project beyond conventional boundaries.
- Engages diverse cultural, historical or scientific perspectives and articulates how these perspectives contribute to a project, paper or performance.
- Develops hypotheses, creates research, scholarship or performance that makes a substantive contribution to the field of study.
- Demonstrates breadth within their learning experiences.
- Implements methodologies and/or practices to test hypotheses and illustrates the implications of the experimental outcome to the field of study and its relationship to allied fields.
- Develops new concepts and methodologies and/or identifies new research opportunities.
- Communicates complex and/or ambiguous ideas clearly.
- Evaluates the implications of one’s own scholarship/research/performance to broader scientific advancement.
- Fosters ethical conduct and adheres to professional guidelines.

- What is the program’s structure? For example, is it a single program or does it have informal tracks/concentrations, formal named options or certificates?

The CBMS program’s structure is a single program with MS and PhD options. MS students often continue to the PhD track after receiving their MS degree or transition to the PhD prior to completing the MS degree. This may happen when the Academic Committee recommends admission of a PhD applicant at the MS program level to allow the student to demonstrate that they have the ability to succeed in a graduate research program. If successful, the student and their mentor can petition the Academic Committee, requesting a program change from the MS to PhD level. On rare occasions, a PhD student may decide to leave the university after completing requirements for an MS degree.

- Describe any substantial and structured collaborations with other programs, such as dual, double or joint degrees and benefits of these arrangements?

The SVM offers DVM/PhD and DVM/MS dual degree programs. The goal of the program is to provide graduate training in basic/translational research that complements training in veterinary medicine. Completion of requirements for the DVM/PhD degrees usually takes eight years, and the DVM/MS degrees are typically completed within five to six years. It is anticipated that the educational requirements of the degree programs will be mutually supportive, equipping students with the research and communication skills required to pursue successful careers in a broad array of fields, including independent research, regulatory agencies, public health or industry. Training veterinary researchers is an essential component of the research
infrastructure that protects the health of animals and humans. Recruitment and training of additional veterinary researchers is critical to meet present and predicted needs of biomedical research. For example, by virtue of their training, veterinarians are uniquely qualified to engage in investigations at the human-animal interface in health and disease. Through research training, the veterinary profession will be better equipped to form partnerships with other health professions to solve environmental, food safety, trade, and re-emerging/new emerging disease issues that may arise.

- If the program is not the only program within the home unit, what are the other programs? If there are several programs in the same academic home, how are they related to one another and what impacts do they have on student learning?

The CBMS Graduate Program is the only graduate program in the SVM. The SVM is comprised of four academic departments: Pathobiological Sciences, Comparative Biosciences, Surgical Sciences and Medical Sciences. The CBMS program is administered by the Department of Pathobiological Sciences. Faculty in the school’s four academic departments train professional students in the four-year professional program leading to the Doctor of Veterinary Medicine (DVM) degree. The majority of CBMS graduate students work on thesis research mentored by SVM faculty and often take some of the same classes as DVM students. As described above, students pursuing the DVM have the option to also complete a PhD or MS degree.

- How do the program’s governance model, program committees, and membership criteria lead to active faculty engagement? How does succession planning work for leadership?

The CBMS Graduate program is administered by the Department of Pathobiological Sciences, one of four departments in the SVM. The SVM Associate Dean for Research and Graduate Training provides funding support and oversight for the CBMS Graduate Program Coordinator, and the Department of Pathobiological Sciences provides administrative support. The Academic Committee of the CBMS program serves as the major oversight committee of the program. As such, it is responsible for coordination and administration of the CBMS program, screening of faculty trainer applications, student admissions, and certification of students’ programs. The Academic Committee is currently comprised of 11 voting members: two members from each of the four departments of the SVM, a member-at-large from outside the SVM, as well as 2 student representatives. In addition, 2 non-voting guests include the previous CBMS program director and the Associate Dean of Research and Graduate Training for the SVM. All faculty trainers are invited to participate in the spring recruiting weekend and new student orientation in the fall. For our recruiting weekend, trainers provide excerpts of their laboratory research to all recruits during morning activities and then meet individually with specific recruits that have indicated a desire to pursue research in the trainer’s field of expertise. Trainers are also invited to the evening reception to meet potential recruits and further discuss research opportunities. Faculty are actively engaged in the Path-Bio 930 Advanced Research Seminar Series, providing feedback to students about their research presentations and giving presentations themselves about their research. This faculty engagement adds to the breadth and depth of the students’
learning experience and fosters research collaboration. Succession planning is a semi-structured process. When the current Graduate Program Director is close to ending their tenure, the Academic Committee will identify a potential new Program Director, and the incumbent will discuss the roles and responsibilities with them. There will be a transition period to learn the nuances of program. Historically, the departing program director stays on the Academic Committee as a non-voting member to assist with the transition.

C. Program Assessment and Evaluation

Summarize the assessment plan used to evaluate the extent to which students are meeting program learning goals and how the program is engaged in a coherent process of continuous curricular and program improvement.

- What has the program learned through assessment of learning goals? Provide key evidence.

In November 2017, we submitted our first assessment report to the Graduate School for both the PhD and MS programs. We focused on learning goals that could be evaluated through direct assessment methods.

For the PhD program, we assessed how well the students:
- Communicate complex and/or ambiguous ideas clearly.
- Evaluate the implications of one’s own scholarship/research/performance to broader social concerns.
- Recognize and apply ethical conduct and professional guidelines.

PhD assessments were made by various methods including:
- Presentation during the PBS 930-Advanced Seminar (n=28; Score: 3.7/4.0);
- Completion of Surgical Science 812-Research Ethics and Career Development (n=32; Score: 4.0/4.0);
- CBMS certification process (38 students were successful);
- Prelim B - Advance to dissertator Status *(n=8; Score: 4.7/6.0 exceeded expectations) and
- Final dissertation defense *(n=4; Score: 4.8/6.0 exceeded expectations).

*number in parenthesis indicates number of students assessed and average score/ maximum possible score of 6; score of 1-2 indicates not meeting expectations, score of 3-4 indicates meeting expectations and score of 5-6 indicates exceeds expectations.

We had a small number MS students in our assessment group. In fall 2017, we admitted 9 additional MS students so future assessment reports will include larger numbers. For the MS program, we evaluated how well the students:
- Articulate, critique, or elaborate the theories, research methods, and approaches to inquiry and/or schools of practice in the field of study.
- Articulate sources and assemble evidence pertaining to questions or challenges in the field of study.
- Demonstrate abilities to apply knowledge through critical thinking, inquiry, and analysis to solve problems, engage in scholarly work, and/or produce creative products.
- Assess or refine information resources or an information base within the field.
- Communicate clearly in styles appropriate to the field of study.

MS assessments were made by various methods including:
- Presentation during the PBS 930-Advanced Seminar (n=2; Score: 3.5/4.0).
- Completion of Surgical Science 812-Research Ethics and Career Development (n=3; Score: 4.0/4.0).
- CBMS certification process (4 students were successful); and
- Final Thesis Defense *(n=1; Score=4.25/6.0 met expectations).

Preliminary data have suggested that our students are meeting and exceeding expectations.

- What changes have been made as a result of assessment?

We have not made substantive changes as a result of our assessment reporting since our first report to the Graduate School in November 2017. Initial reports indicate that the majority of our students are meeting program goals and objectives. As more data become available, the Graduate Program Director and the Academic Committee will review assessment findings each year prior to reports being submitted to the Graduate School and in conjunction with feedback from our 10-year program review and Graduate School exit surveys to determine what changes need to be made.

- What are the emerging changes in the discipline? What is being done and can be done to move forward and seize emerging/future opportunities?

The greatest change in the discipline is the increased realization and acceptance of the One Health concept. The One Health concept links human, animal and environmental health. The One Health Initiative is an integrated effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals, and the environment. The importance of the One Health Concept is underscored by the fact that at least 75% of emerging and re-emerging diseases are either zoonotic (spread between humans and animals) or vector-borne (carried from infected animals to others through insects). Climate change, increased international travel and commerce facilitate dissemination of infectious diseases across countries and even continents with relative ease. The CBMS program strongly embraces the One Health concept and is committed to training our students to be at the forefront of global infectious disease research.

One of the major strengths of our research program is infectious diseases, especially in the areas of virology, vaccinology, epidemiology, medical entomology, ecology, host-pathogen-environment interactions and the study of vector-borne diseases. We have several nationally and internationally-recognized trainers, who have been very successful at securing grants and mentoring students in diverse facets of infectious disease. For example, in January 2017, CBMS...
trainers Dr. Susan Paskewitz (Entomology Department) and Dr. Lyric Bartholomay (Pathobiological Sciences Department) received a $10 million grant from the Centers for Disease Control and Prevention (CDC) to establish a new research and training program to stem the spread of diseases carried by vectors like ticks and mosquitoes. The Midwest Center of Excellence for Vector-Borne Disease (MCE-VBD) brings together academic and public health expertise from Illinois, Iowa, Michigan, Minnesota, and Wisconsin. The MCE-VBD offers increased training opportunities at all levels, including undergraduate, graduate and professional students. Current students and post-docs from the CBMS program are contributing to the Center’s research. Notably, the CBMS program has increased its recruitment of students with professional degrees, particularly those who have already earned a DVM degree. With the continued funding (now year 12) of the NIH T32 training grant “Research Training in Comparative Biomedical Sciences for Veterinarians” (Dr. Charles Czuprynski, Director), we have successfully recruited additional veterinarians into our graduate program. Furthermore, the recent inauguration of the combined DVM/PhD program at the SVM further aids the development of veterinary medical scientists by the CBMS program. The CBMS program is uniquely designed to generate the next generation of highly trained scientists in the areas of infectious disease, global health and One Health.

- If relevant to the program, how do leaders within industry, business, government, or non-profit organizations become involved in offering advice and perspectives on the program and the curriculum?

The CBMS program has trained several individuals who have assumed leadership roles in industry, government and non-profit organizations. We connect with them regularly via SVM publications such as ‘On Call’, in which we highlight current research and other accomplishments by students and faculty of the CBMS program. Additionally, the SVM Development personnel are in regular contact with SVM/CBMS alumni. By staying connected with alumni, we receive valuable advice and feedback about the program. SVM also invites prominent alumni from industry, government and academia to speak to and advise students about different career paths and pathways to successful careers in their chosen field of endeavor. Visiting alumni provide critical information about how the CBMS program can assist students in developing credentials and experience needed to pursue various career paths.

D. Recruiting, Admissions, and Enrollment

Analyze current practices and trends to determine if enrollment levels are consistent with plans and program resources. Discuss relevant program data in the context of the following:

- Are admissions practices and enrollment levels consistent with plans, program resources, and career outcomes?

Admission remains very competitive. Applicants must hold a B.S., DVM., M.S., M.A. or M.D. from an approved institution and have a strong background in biology and chemistry. During the first stage of admission, applications are objectively evaluated, with the three most important criteria being: 1) academic credentials based on their transcripts and CV looking for
evidence of rigorous coursework, significant research and breadth of experience; 2) a description of their reasons for pursuing graduate study in the CBMS program and creative thinking, demonstrated by a well-crafted essay that clearly articulates the significance of their research interests; and 3) potential for success in graduate work as indicated in letters of recommendation. We average about 45 PhD and 15 MS applications each year and recommend admission for approximately 22 PhD and 7 MS students. Admissible domestic PhD applicants are invited to the UW campus during a recruitment weekend, allowing students to meet with Professors and explore possibilities of joining their programs. Before final admission to the Graduate School, students must identify an eligible program faculty member who agrees to serve as their major professor. Approximately 50% of the invited students find matches with program faculty members in the 3-4 weeks after the recruitment visit; a limited number of students may be offered rotations before they choose a laboratory. PhD matriculation is dependent on obtaining a funded research assistant or teaching assistant position. Each year we typically welcome an incoming class of 6-9 PhD, 3-5 MS and 1-2 Dual Degree DVM-PhD students, which represents a comfortable number of students to bring into the program. Although we conduct a coordinated admission and recruitment process, the program is flexible, allowing year-round admissions, with most students beginning in fall. Because we compete with the best programs in the country, and other exceptional bioscience programs on the UW campus, some students decline enrollment in the CBMS program. The majority of CBMS PhD graduates pursue postdoctoral fellowships. However, a small number of students find jobs in industry or government upon completion of their degree. Along with the Graduate School, the CBMS program emphasizes the career development of graduate students. All CBMS students are encouraged to develop an IDP and discuss the plan with their mentor. The mentor or the Graduate Program Coordinator will guide students to resources about career choices post-graduation. During orientation and recruitment, the program director emphasizes various resources such as the writing center and the Delta program that are available to graduate students to improve their competency to pursue various career paths. As mentioned above, the SVM invites accomplished scientists from industry, government and academia to advise students about the variety of career choices available to them.

- What effort has the department/academic unit or program made to enhance student diversity (traditionally underrepresented groups in field)? Have those diversity efforts been successful?

The CBMS graduate program has always emphasized recruiting and retaining a diverse population of students. We use several mechanisms to increase the numbers of underrepresented applicants to the CBMS program. The CBMS Graduate Coordinator is a member of the Biosciences Opportunities (BOPs) committee, working with other BOPs members to introduce highly qualified prospective graduate students to the breadth of research opportunities available in bioscience PhD programs offered at UW-Madison. Many faculty mentor underrepresented undergraduate students in a variety of summer research programs. These students are strongly encouraged to apply to the CBMS program. Our program is always represented at the summer research graduate fair on campus. Attendees who express an interest in our program are contacted by email. Faculty members take promotional materials
when they attend conferences and visit universities around the country. For example, this summer, CBMS presented at the National Veterinary Scholars Symposium held at Texas A&M. In the past, the CBMS program has teamed up with Dr. Theresa Duello (Director of Diversity Initiatives in the UW Department of Gynecology and Obstetrics) to recruit underrepresented minority students from institutions on the east and west coasts. Dr. Duello handed out CBMS promotional materials to interested students during her visits and gathered email addresses of students interested in our program. The Graduate Coordinator contacted these students to provide additional information and invite them to apply to the CBMS program. The CBMS program will continue its unwavering commitment to recruiting talented minority students. We made offers to 9 of 13 URM applicants who applied for either summer or fall 2018. Six were nominated for Advanced Opportunity Fellowships with SciMed GRS and four were offered fellowships. Four URM recruits (3 PhD, 1 MS) chose to join the CBMS program, with two of them being funded by SciMed GRS fellowships. Our program is relatively small with only 45 PhD and 14 MS students, yet 7 students or 12%, are domestic targeted underrepresented students. We are proud of our past success in this important area and are committed to build on this success in the future.

- If applicable, what do trends in application volume, admits, and enrolled students signal about program strength? For graduate programs, does the program directly admit students? If so, how does the program ensure student integration and success beyond the admitting advisor?

As previously mentioned, CBMS receives about 41-55 PhD and 16-18 MS applications each year. These numbers have remained relatively constant over the last 5 years. The number of new students who enroll in CBMS each year ranges from 5 to 11 PhD and 3 to 10 MS students. Although the number of applications remains relatively constant, we are seeing a palpable increase in the number of applicants interested in infectious disease ecology, emerging infectious diseases, viral evolution, global health and vector-borne diseases.

The CBMS program utilizes a hybrid direct-admit program. Students found to be admissible have a chance to explore possibilities of working with different mentors before choosing one and being formally admitted by the Graduate School. This process is facilitated during the recruitment weekend, when prospective students meet with several trainers in one-on-one sessions and during evening receptions. During the recruitment weekend, many faculty trainers who are interested in taking a student provide excerpts of their research program in short talks.

The CBMS program does a number of things to ensure student integration and success beyond the admitting advisor. First, all students are required to attend and present seminars in the Path-Bio 930 Advanced Research Seminar Series. Here, students learn about the research of other graduate students and trainers in the CBMS program. CBMS faculty provide feedback to students about their research presentations and give presentation about their research. Thus, Path-Bio 930 Seminar serves as a critical avenue to integrate students into the program, adds to the breadth and depth of the students’ learning experience, and fosters research collaboration. Second, the SVM sponsors a Research Day each year at which CBMS students, along with
residents and DVM students, give oral presentations or present posters about their research. Third, the CBMS program fosters cohesiveness among students by hosting a picnic at least once a year, inviting all students to participate in our spring recruiting weekend evening reception, and attending a potluck lunch at new student orientation day in the fall. Fourth, the Dean of SVM provides refreshments and hosts a monthly get-together for all members of the SVM, including CBMS students. This social forum allows students to meet and interact with one another. Fifth, CBMS students participate in book clubs and diversity forums to foster an inclusive environment and mitigate against discriminatory behavior/practices in the program.

E. Advising and Student Support
   Discuss the process by which students get regular advising and accurate program information. Reflect upon the following:

   Post-Baccalaureate:
   • How are advisors assigned and matched to students? How many advisees does each faculty member have?

   The majority of our entering students are admitted under the mentorship of a specific professor. We believe this one-to-one match upon admission strengthens the mutual investment that the student and trainer make towards the success of that relationship. Additional mentorship is provided by the student’s thesis committee, which they are required to identify by the end of their first year. The number of advisees per CBMS trainer varies widely. One of the strengths of the program is that students can choose to work in a lab environment that is the best fit for them. The Graduate Program Coordinator serves as a point person to advise and provide accurate information about the programmatic requirements. Additionally, the CBMS program Director is available for consultation/advice to clarify programmatic requirements and resolve issues related to the program. Our program is interdisciplinary with approximately 95 campus trainers. Many trainers also have advisees in other bioscience graduate programs.

   • How often are program contacts and student handbooks updated and made available online? Is the handbook inclusive of program learning goals, program requirements as well as a program-level grievance procedure?

   We strive to keep the CBMS website (link here) current and relevant. The website contains information for prospective and current students and trainers. Program contacts are updated on the website whenever changes occur. The graduate program coordinator has access to make edits directly to the website. The handbook (link here) which includes program learning goals (link here), program requirements (link here) and program-level grievance procedures (link here) is updated each summer.
• How are students transitioned between advisors when personnel changes?

The majority of our students are funded by their faculty mentor through a research assistant position. This faculty member serves as the primary advisor to the student throughout their graduate study with additional mentorship being provided through the student’s thesis committee. If an occasion arises that causes a student to seek a new advisor, as in the case of advisor leaving the university, the student will work directly with the program director and program coordinator to find a new advisor. First, we will look to the student’s existing committee to determine if there is an available advisor and funding. If one does not exist, we will continue to seek a lab match with other trainers in the program. In the past, the CBMS program has offered rotation to students that are seeking to change labs and will continue to do so in the future if funds are available.

• How often and in what manner is satisfactory progress monitored? Do students receive written annual feedback on their academic progress?

Students are required to meet at least once per calendar year with their thesis committee, or to complete the Prelim A exam or Prelim B exam. At every annual meeting, students receive evaluation and feedback from the thesis committee as described below. In the first year, students meet with the thesis committee and complete their certification document. Certification includes providing a brief description of their research, the scientific contributions of each committee member to the student’s thesis research and the planned coursework. The certification form is signed by the thesis committee members and then approved by the CBMS Academic Committee to insure it meets program and Graduate School degree requirements. For PhD students, Prelim A and Prelim B in the second and third year respectively provide opportunities to evaluate and provide feedback on the students’ academic progress. If for some reason Prelim A or Prelim B are not scheduled in the second or the third year, the student will instead convene the annual committee meeting. Students distribute a written progress report to their committee, and provide a brief presentation to their committee. The committee evaluates the progress report and presentation, fills out an evaluation form, and discusses it with the student. The student submits the form to the graduate program coordinator who keeps it on file in the student’s permanent record. A similar process is followed for MS students. Evaluation forms are located on the CBMS website (link here) and at the end of the handbook (link here).

• How is the impact of advising assessed?

CBMS Trainers/Advisors/Mentors are tenure track faculty at UW-Madison qualified to offer outstanding research training. Faculty can apply to become Trainers and are screened by the Academic Committee. Criteria for obtaining trainer status include evidence of grants to support potential students as well as suitability of training area. Typically, an advisor’s impact is assessed through exit survey data. Students are encouraged to maintain an open relationship with their mentor. While most students find their relationship with their mentor to be a positive one, there are times when a change in thesis laboratory is necessary. In the event that
this relationship breaks down, the student contacts the program director or the program coordinator. These situations are handled on a case-by-case basis. Historically, we have been very successful at finding new advisors, when necessary, within the trainer community.

F. **Program Community and Climate**

Where applicable, evaluate exit survey and climate survey data. Describe the efforts taken to foster overall program diversity, a climate of respect and inclusion, and a sense of community by considering the following:

- Discuss efforts to welcome, orient, and retain new students. What is offered to connect students within the program, as well as with the greater campus community?

After a student formally accepts the offer of admission, the Graduate Coordinator begins the process of welcoming the student to campus. New students are informed by email about enrollment dates, activating their NetID, registering for classes, recommended courses, WisCard ID processes and how to obtain their bus pass. Because of the large number of international students in our program (36%), we frequently encounter issues with obtaining visas and housing. These are handled on a case-by-case basis as needed. New student orientation held for the group of incoming students is the first formal program activity. This session provides an opportunity to introduce the students to one another and the staff. Historically, they are welcomed to the program by Dr. Mark Markel, Dean of the SVM; Dr. Dale Bjorling, Associate Dean of Research and Graduate Education-SVM; Dr. Charles Czuprynski, Chair of the Pathobiological Sciences Department; and Dr. Suresh, Graduate Program Director. Orientation also covers information regarding the academic program structure and requirements. The session ends with a Q&A with current students, which allows the students to hear about various aspects of graduate school from a student’s point of view.

As mentioned earlier, CBMS students are required to enroll and participate in PBS 930 – Advanced Research Seminar (4 semesters for PhD, 2 semesters for MS). This seminar series brings the CBMS students together every week during the academic year and has served well to promote cohesiveness and make students aware of the diverse multidisciplinary research being done by their colleagues in the CBMS program. Students are also strongly encouraged to participate in journal clubs and seminar programs supported by their own labs and other departments, based on their individual scientific interests. There is a very collegial environment within CBMS, in which trainers and students interact frequently and enjoy a good rapport. The Graduate Director, Dr. Suresh, is very involved in the program and available to students to discuss issues related to their graduate career and research. The program coordinator distributes a weekly electronic bulletin that informs students about important developments in the program, grant availability and deadlines, awards/achievement of CBMS faculty/students, thesis defenses and seminars. CBMS hosts social events to foster camaraderie and collaborations, and such as new student orientation, a fall cook-out, and spring recruiting with student-hosted dinners. The CBMS program, with support of Graduate Director Dr. Suresh, SVM Deans Markel and Bjorling and PBS Chair Dr.
Charles Czuprynski, has increased community building efforts via the CBMS graduate student seminar series, participation in diversity workshops and a student-led book club focused on ethical and cultural topics. We acknowledge that more can be done and are open to opportunities to learn how to improve our program climate.

- What efforts are there to enhance faculty/staff representation of traditionally underrepresented groups in the field? How does the unit rate its ability to attract and retain a diverse faculty/staff?

CBMS trainers, students and staff are committed to increasing the number of underrepresented minority students and creating an environment that is inclusive of various cultures. One of the school’s fundamental principles is to foster a climate of diversity and inclusivity that is infused with high ethical standards, professionalism, and compassion. Diversity of students is addressed by one of the seven strategic priorities within the SVM, which is to recruit a diverse and high-caliber population of students and support their success. The School of Veterinary Medicine also has an Engagement, Inclusivity and Diversity Committee. Dr. Joan Jorgensen, a member of the CBMS Academic Committee represents our graduate program on this committee. We ask that all trainers incorporate diversity and inclusion practices in their mentoring. Indeed, several CBMS trainers have volunteered and/or currently serve as committee members in the SciMed GRS program. Leadership at SVM anticipates a large number of faculty retiring over the next several years. They are dedicated to recruit and develop high-caliber and diverse faculty. For example, two of the recent tenure track faculty hires in the Department of Pathobiological Sciences are women from URM.

G. Degree Completion and Time to Degree
Referencing relevant data and campus goals, describe efforts to help students make timely progress to degree. Include the following in your discussion:

- Use institutional data sources to examine and evaluate progress to degree metrics and comparison to peers.

We believe that the procedures and evaluations put into place over the last 8 years have significantly improved our time to degree. Our students complete the PhD program on an average of 1.0 years before our AAU Peer Institutions. The average CBMS time to degree completion is currently 4.3 years compared to AAU Peer data of 5.2 years (link here). The majority of CBMS PhD students finish within 5 years, 60.7%, compared to 41.1% for all UW biological science PhD students, and 33.8% of all UW Madison PhD students in the same time frame (link here). This diagram helps to illustrate CBMS time to degree in comparison to individual biological science PhD programs (link here). The favorable time to degree record of the CBMS program is attributable at least in part to the hybrid-direct admission policy that allows students to start their thesis research 3-4 months earlier than students who do 3 rotations prior to choosing a lab. Furthermore, we believe that reduced time-to-degree is promoted by strong mentor/student relationships and support from the CBMS community and
SVM. We believe that processes put into place will further decrease the percentage of individuals that fall outside the 5 year range.

- What efforts have been made to improve progress to degree performance and completion rates?

As previously mentioned, the CBMS program implemented the use of the program *Filemaker* to track the progress of CBMS students. In the past few years however, those data were converted to an Excel spreadsheet for continued monitoring. To facilitate student progress, the CBMS Academic Committee has implemented a series of "checkpoints" to ensure that students make timely progress to their degree. The CBMS Program Coordinator tracks each student’s progress through these checkpoints and sends reminders when appropriate. The Academic Committee will, if necessary, follow up on any delays through conversations with both the student and the major professor. Also, as stated in section A - *response to previous program review recommendations*, the Academic Committee reduced the total number of didactic credits required for the PhD degree from 25 to 20.

- Do students from educationally underrepresented groups (racial/ethnic minority, low-income, first generation in college) succeed in the program at rates comparable to other students? How are equity gaps addressed?

In the CBMS program, the degree completion rates for targeted domestic underrepresented minority students is comparable to those of non-targeted domestic PhD student and international PhD students (*link here*). Notably, when we compare the CBMS targeted minority completion rates to the completion rates for the Biological Sciences and all UW Madison targeted minorities (*link here*), we have a slightly larger percentages of students finishing their PhD program or obtaining an MS degree, which contributed to a lower overall percentage of students that failed to finish their program. Equity gaps are addressed by participating in the events supported by the UW-SciMed GRS program. As mentioned earlier, CBMS trainers are actively involved in reducing equity gaps by serving on committees in the SciMed GRS program.

H. **Career Services and Post-Graduation Outcomes**

*Evaluate student career outcomes, exit survey, and alumni survey data, and reflect upon how these outcomes are consistent with program goals.*

- What do students do after graduation? How does the program prepare them for careers or further academic training?

Our program places 80% of graduates into the field of education (postdoctoral positions at universities or NIH. Recent examples include Harvard Medical School, UW-Madison, University of Michigan, University of Maryland, University of Miami and Carnegie Institute for Science). Approximately 10% progress into private, for-profit agencies (e.g., pharmaceutical companies) and 10% choose to go into not-for-profit agencies (*link here*). Outside of academia, veterinary medical scientists play critical roles as scientists in the USDA, CDC and national wildlife labs,
toxicologists and pathologists in the pharmaceutical industry and public health leaders in the state and federal government. Furthermore, NIH has indicated the critical need for veterinarians trained in research to advance the concept and practice of the One Health model. The focus of the biomedical research program provided by our trainers emphasizes the study of animal diseases and physiology, the use of appropriate animal models to model human development and disease and to interrogate crosstalk between human and animal medicine. Therefore, by training scientists in diverse disciplines related to animal and human health, the CBMS program fits a specific and increasingly important niche within the biological science graduate programs on campus and across the country. The CBMS program promotes career development and prepares students for further academic training in many different ways. First, the research and coursework are designed specifically for each student, building on their prior academic accomplishments, individual strengths and weaknesses, and career goals. Individualized programs can range from clinical aspects of human or veterinary medicine to research that focuses on the cellular and molecular mechanisms of health and disease. Second, CBMS and the SVM promote career development by bringing in accomplished individuals from industry, government and academia to advise students on the path to meeting their diverse career goals. Third, we arrange grant-writing and scientific writing workshops for students to hone their proposal-writing and other written communication skills. Fourth, we strongly encourage students interested in teaching to enroll in the UW Delta program. Occasionally, we have funded graduate students to visit labs or workshops in other institutions to acquire specialized training required for their current and/or future research. In summary, graduate students in the program acquire the critical thinking, theoretical background and contemporary laboratory skills needed in academia and industry, and to assume leadership roles in biomedical and veterinary research.

- What career resources are available to students?

As previously noted, the CBMS program, in conjunction with the SVM, has hosted seminars on career paths for PhD students, financial literacy and grant writing. Two popular elective courses, offered by CBMS trainers that are strongly recommended to our students are "Research Ethics & Career Development" and "Scientific Manuscript Writing Using Storytelling Methods". We encourage CBMS students to attend training and workshops offered by the graduate school. Our students have also participated in seminars on teaching and learning techniques (Provided by visiting Professor Dr. Simon Lygo-Baker, Surrey University, UK). Many workshops offered at the School of Veterinary Medicine for the DVM students and interns are open to the CBMS graduate students.

- What is the range of student career outcomes, and are these outcomes consistent with program goals? Does the program track the career progression of its graduates?

As previously stated, our program places 80% of graduates into the field of education, with the vast majority of them pursuing postdoctoral positions at tier-one research universities or government agencies such as the NIH or USDA. Our program goals are to train the next generation of biomedical researchers. Students enrolled in the CBMS Program tend to be
independent, well-motivated graduate students who are productive while at UW-Madison and who successfully move on to positions in academia and industry. Although we currently do not track the career progressions of our graduates, there are ongoing efforts to do so in the near future.

I. Overall Analysis of the Self-Study and the State of the Program:
   Outline key findings from the self-study, including primary program strengths and challenges, and priorities the program has identified for improvement.

As described throughout this document, the CBMS program is in an excellent state and possesses multiple strengths. First and foremost, the CBMS program occupies a distinct training niche in the spectrum of biomedical research by developing veterinary medical scientists who are uniquely trained to investigate diseases at the animal-human-environment interface. This distinction is supported by: (1) the NIH T32 grant (PI is CBMS trainer Dr. Charles Czuprynski) to provide research training to individuals with a DVM degree; (2) the NIH T35 grant (PI is CBMS trainer Dr. Dale Bjorling) that provides research experience to DVM students; and (3) the newly funded DVM/PhD dual degree program in the SVM.

In this era of globalization, infectious diseases jump species, cross international borders and potentially develop into global public health nightmares. Significantly, several of the emerging and reemerging infectious diseases are either zoonotic (e.g. MERS-Coravirus, avian influenza virus, SARS-Coronavirus, ebolavirus) or transmitted by vectors such as mosquitoes and ticks (e.g. Zika virus and Chikungunya virus). The CBMS program and the SVM embrace the One Health initiative to tackle these infectious diseases of global health importance. The CBMS program has several nationally and internationally recognized trainers in the area of zoonosis, global health and disease ecology, medical entomology and vector-borne diseases. As previously mentioned, CBMS trainers Drs. Lyric Bartholomay and Susan Paskewitz were awarded $10 million by the CDC to create the Midwest Center of Excellence and train scientists in vector-borne diseases. Another noteworthy facet of the CBMS program is the availability of international training opportunity for graduate students. For example, CBMS trainers Dr. Tony Goldberg and Jorge Osorio have research programs based in Uganda and Columbia, respectively, in which their students perform thesis research in foreign countries.

The CBMS program currently has 95 faculty trainers from a wide array of departments at UW-Madison who offer expertise in a variety of disciplines, including biomedical engineering, mathematical modeling, genomics, cancer biology, neuroscience, developmental biology and immunology. The interdisciplinary nature of the CBMS program is a substantial strength, particularly in light of the current shift toward pursuing science by forming multi-disciplinary teams. Scientific projects are often complex and require diverse expertise that transcends specific disciplines. For example, future biomedical scientists will need the expertise in genomics and mathematical modeling to make sense of complex data sets.

The CBMS program has many strengths, and a few challenges. One obstacle is the geographical dispersion of faculty and students across many departments. This situation presents challenges
to building and maintaining a cohesive program. Although we have made strides in integrating students with diverse interests via advanced seminars and social activities, we continue to strive for unifying, community-building events that bring our students together to create a stronger sense of inclusion, camaraderie, and well-being. Social events that bring students together are mostly centered on recruiting and orientation. There is a tendency for these events to be well attended by first and second year students. We need strategies to stay connected with advanced students who have less interaction in class and find themselves spending the majority of time in their laboratories. Events such as a program retreat and regular student meetings are options that the program is considering to strengthen the CBMS community.

Although the hybrid recruit-direct admit policy has worked well for the CBMS program, (e.g., reduced time-to-degree), this policy also poses some challenges in recruiting exceptional graduate students into the program. For example, a highly recruited prospective student might be interested in a particular trainer, but that trainer is waiting to hear from a granting agency and therefore does not have the resources to support the student. In this case, the program cannot guarantee the student financial aid if the trainer does not receive funding. Availability of fellowships to support such meritorious students will enhance the quality of students in the program. Some trainers are reluctant to admit graduate students into their labs without rotations. However, we are limited in our ability to provide rotations because we lack funds to support these students if they fail to join the lab of their choice. We are able to provide rotations only when more than one trainer is interested in a student, or when the student is switching labs during their program. To further improve our ability to recruit high quality students, we need financial resources to guarantee student funding regardless of which lab they choose to join following rotations.

Additional Considerations for Graduate Students

J. Funding

*Discuss the program’s student funding data and mechanisms, along with any goals for providing funding guarantees. Include a discussion of funding issues, such as:*

- How is the program ensuring PhD students have adequate funding and taking steps to provide a multi-year funding guarantee upon admission? Are there opportunities for graduate students to secure individual extramural support? What efforts are made to ensure PhD students have funding?

Student funding typically begins at the start of their first year with continued support through graduation. The majority of students in CBMS are supported by their mentors as Research Assistants through federal grants from the NIH, NSF, or USDA. A small percentage of international students are supported by their foreign governments (Egypt, Brazil). Also, the Comparative Biomedical Sciences Research Training for Veterinarians (T-32 grant) program provides funding for a total of four graduate veterinarians to receive research training for the PhD. The CBMS program currently has three of the four PhD students funded by this grant, with
the fourth slot being held by a PhD candidate in the Cellular and Molecular Biology graduate program. This 5-year training grant was renewed in 2017 (12th year overall). The T32 program grant supports 3 years of the PhD program. Historically several of the trainees also received extramural grant/fellowship support (Morris Animal Foundation, American Association of Immunologists and American Kennel Club Canine Health Foundation Clinician-Scientist Fellowship) for the 4th and 5th year of the PhD program. The program encourages students to apply for extramural grants to support their stipend and tuition. In the past, CBMS students have received fellowships from NSF and Merck Animal Health, and recently one student was the recipient of pre-doctoral fellowship from the American Heart Association. CBMS has nominated students for the Howard Hughes Pre-doctoral fellowship. Many trainers with NIH grants also receive diversity supplements to support the stipend of underrepresented minorities. Trainers in the CBMS program are affiliated with other training grants (Virology, Microbes in Health and Disease etc.) and their CBMS students have received support from them. Historically, almost all PhD students in the CBMS program have received funding throughout their graduate program. The Graduate School fall research competition award has been sporadically used by trainers to address lapses in student funding. On rare occasions, when the trainer was between grants or lost grant funding, the SVM and/or the trainer’s department have supported graduated students. Currently, the SVM is committed to, and is exploring, ways to guarantee multi-year funding to all future CBMS students.

- To what extent is the program making use of funding for diversity efforts?

As described above, Graduate Student Support Allocation and AOF funds are used to fund recruiting activities for under-represented minority students. SciMed GRS Fellowships will be used to fund two incoming fall 2018 CBMS graduate students. CBMS trainers, students and staff are committed to increasing the number of underrepresented minority students and creating an environment that is inclusive of various cultures. One of the school’s fundamental principles is to foster a climate of diversity and inclusivity that is infused with high ethical standards, professionalism, and compassion. Diversity of students is addressed by one of the seven strategic priorities within the School of Veterinary Medicine, which is to recruit a diverse and high-caliber population of students and support their success. NIH-supported trainers routinely apply for diversity supplements to fund underrepresented minorities in the CBMS program. Further, campus T32 grants are an excellent source of funding for underrepresented minorities.

K. Professional Development and Breadth

- How does the program encourage students to participate in professional development opportunities that will enhance their skills and support their career goals?

CBMS students are informed during orientation and by weekly bulletins regarding other programs and courses about professional development that are available to them. Students are also informed about programs supported by the Delta Program (a program supported by the Center for the Integration of Research, Teaching and Learning [CRTL]) such as the graduate
student-mentoring seminar, the certificate program and the many other options offered by Delta. We also encourage our students to explore offerings by the Graduate Student Collaborative. This collaborative serves as a resource and a voice for UW-Madison graduate students within the Graduate School. We also have senior graduate students speak to incoming students about the range of professional development opportunities that they have utilized during graduate studies.

- What resources and guidance are available for exploring academic and/or non-academic careers?

One mechanism by which the SVM promotes career development is by inviting accomplished individuals from various fields. For example, at the 2017 SVM Fall Research Day, Tom Cherpes DVM (’89), MD (Wake Forest, ’98) gave a presentation on his career path and career options available to students in Comparative Medicine. CBMS alumnus Mary Haak-Frendscho recently gave a special guest seminar for students interested in building a career in biotech. She is a venture partner with Versant Ventures and CEO of Blueline Bioscience. Versant Ventures is a Canadian discovery engine, working with exceptional entrepreneurs to create and build the next generation of great biotechnology companies in Canada. Mary also serves on the Boards of Sirenas and Northern Biologics. The SVM continues to develop and organize seminars and workshops focused on topics of interest to our students.

- How is the program using Individual Development Plans, which are recommended for all graduate students and required for those with NIH funding?

At new student orientation and throughout their graduate career, students are strongly encouraged to develop and maintain their IDP. Students are instructed that the IDP serves as a start to the conversation between students and their faculty advisors about their career goals and professional development needs. NIH-supported students are instructed that they are required to complete an IDP. The program tracks if students have created an IDP through the IDP tracking system and includes a question about IDPs on various evaluation forms. Many CBMS students discuss their IDPs in annual meetings. Overall the IDP is considered to be the student's responsibility, and they are not required to share details, only to meet and discuss concerns and plans with their mentor. The Academic Committee has discussed making IDPs mandatory in response to recent Graduate School exit survey results.

- What opportunities and funding are available to attend and present at professional meetings?

Through the generous support of the Daryl and Sharon Buss Graduate Program Fund, administered through the SVM, our program has the ability to provide financial assistance for research or conference travel each year. Historically, we have also used a portion of our graduate student support allocation funds to support student travel. Preference is given to PhD students with dissertator status. MS students are considered based on quality of the work,
applicant pool and funds available. Below is a list of recent travel requests supported by CBMS funds.

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Location</th>
<th>Year</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veterinary Cancer Society (VCS)</td>
<td>Louisville, KY</td>
<td>2018</td>
<td>$1000</td>
</tr>
<tr>
<td>NIH Malaria and Vector Research</td>
<td>Rockwell, MD</td>
<td>2018</td>
<td>$500</td>
</tr>
<tr>
<td>American College of Veterinary Ophthalmologists (ACVO)</td>
<td>Minneapolis, MN</td>
<td>2018</td>
<td>$1000</td>
</tr>
<tr>
<td>Society for Theriogenology</td>
<td>Milwaukee, WI</td>
<td>2018</td>
<td>$700</td>
</tr>
<tr>
<td>Midwest Plant Cell Dynamics</td>
<td>Madison, WI</td>
<td>2018</td>
<td>$300</td>
</tr>
<tr>
<td>American Association for Cancer Research (AACR)</td>
<td>Chicago, IL</td>
<td>2018</td>
<td>$1000</td>
</tr>
<tr>
<td>Orthopaedic Research Society (ORS)</td>
<td>New Orleans, LA</td>
<td>2018</td>
<td>$1000</td>
</tr>
<tr>
<td>International CD1-MR1</td>
<td>Napa, CA</td>
<td>2017</td>
<td>$1000</td>
</tr>
<tr>
<td>ACVP and ASVCP Concurrent Annual Meeting</td>
<td>Vancouver, BC</td>
<td>2017</td>
<td>$700</td>
</tr>
<tr>
<td>International Society on Thrombosis and Hemostasis Congress</td>
<td>Berlin, Germany</td>
<td>2017</td>
<td>$1000</td>
</tr>
<tr>
<td>15th Annual Ecology and Evolution of Infectious Disease Mtg</td>
<td>Santa Barbara, CA</td>
<td>2017</td>
<td>$1000</td>
</tr>
<tr>
<td>Society of Invertebrate Pathology Annual Meeting</td>
<td>San Diego, CA</td>
<td>2017</td>
<td>$1000</td>
</tr>
<tr>
<td>American Transplant Congress 2017</td>
<td>Chicago, IL</td>
<td>2017</td>
<td>$1000</td>
</tr>
<tr>
<td>Annual Meeting of the Orthopaedic Research Society</td>
<td>San Diego, CA</td>
<td>2017</td>
<td>$1000</td>
</tr>
</tbody>
</table>

- To what degree does the program offer teaching experience and teaching-related professional development to graduate students?

The majority of students in the CBMS program are funded through either Research Assistant positions in their mentor’s research labs or through Academic Staff positions in the School of Veterinary Medicine. A few students have gained teaching experience by working as Teaching Assistants in courses offered by the departments of Medical Microbiology and Immunology or Zoology. It is not uncommon for graduate students to participate in courses taught by their mentors. Teaching experience and teaching-related professional development for our students come from exposure to the Delta Certificate Program or professional development programming offered by the Graduate School. Additionally, CBMS students have participated in seminars on teaching and learning techniques (provided by visiting Professor Dr. Simon Lygo-Baker, Surrey University, UK). Dr. Lygo-Baker has been a visiting professor for the last five summers and has educated students and faculty about novel strategies to become an effective teacher and how to enhance student engagement and learning in the classroom. Many workshops offered at the School of Veterinary Medicine for the DVM students and interns are open to CBMS graduate students.

- How does the typical graduate’s program ensure exposure to breadth training? Does the program require a doctoral minor for doctoral students or evaluate other breadth requirements?

The CBMS program is an interdisciplinary program by nature that has trainers associated with graduate and professional programs across campus. The program presently has 95 faculty trainers (link here) and 59 CBMS students (link here). The breadth of the CBMS trainers is one
of the great strengths of the program. It is not uncommon for a student to have 3 different departments represented on their committee. Our trainers come from the 4 academic departments in SVM as well as a diverse number of University of Wisconsin-Madison departments, including Bacteriology, Biochemistry, Human Oncology, Medical Microbiology and Immunology, Medicine, Pathology, Dermatology and Engineering. All CBMS students and trainers are invited to the public portion of MS/PhD thesis defenses. The graduate coordinator sends out a weekly news bulletin every Monday informing the trainers and students about seminars, workshops, training/employment opportunities, grant announcements, etc. PhD students must complete 4 semesters of Path-Bio 930 - Advanced Research Seminar and MS students must complete 2. Seminars are routinely attended by faculty from the 4 departments in the SVM and other trainers in the CBMS program. Path-Bio 930 provides a forum for graduate students to hone their public speaking skills and their ability to effectively communicate science while increasing their breadth of interdisciplinary knowledge. Also, by participating in, and presenting at, an organized CBMS seminar series, students gain an appreciation of the breadth and depth of research being conducted by fellow students in the program.

A minor is no longer required but may be completed by students who wish to receive one. Since the Graduate School removed the requirement of a minor, only a small percentage of students have pursued one. Historically, the PhD minor in Clinical Investigation offered through the Institute for Clinical and Translational Research has been popular with our Dual DVM/PhD students.