External Review Report for the New Interdisciplinary Graduate Degree Program: M.S., Ph. D. in Comparative Health Sciences

The external reviewers met in Corvallis, Oregon on the Oregon State University campus hosted by Graduate School Dean Brenda McComb on October 21, 2013 to review the proposed comparative health sciences interdisciplinary graduate program proposal. Prior to our site visit, the reviewers were provided in advance with the original proposal and documents tracking the prior steps in internal review – including external written evaluations – that had occurred to date. The reviewers are herein providing their views and opinions on the specific questions asked in the OSU document: External Review of New Graduate Level Academic Programs.

1. Program

   a. The program objectives and requirements; the mechanisms for program administration and assessment.

The **objective** of the Comparative Health Sciences (CHS) graduate program at Oregon State University is to focus on the whole animal level, particularly the use of animal models in the study of disease. As such, it positions itself as an organismal biology complement to the existing Molecular and Cell Biology (MCB) graduate program. Using approaches that bridge multiple disciplines, students in the CHS program will use integrative approaches to both basic and translational research to address biological and comparative medical problems, while focusing on studies of the function and/or behavior of the whole animal. The complementarity of the CHS and MCB programs is viewed by the reviewers as an overall strength – whereas the latter will largely address the needs of those interested in the reductionist study of important molecular and cellular details of biology, the new CHS program provides the framework for study of biological phenomena on a broader, synthetic, and integrative scale.

Currently one option (or track) is available in the CHS program, Biomedical Sciences. Both MS and PhD degree options are available. The general **requirements** for study in the CHS program conform to OSU graduate degree guidelines, and include courses in Research Perspectives, Methods of Data Analysis, Biomedical Ethics, Grant Application Preparation, and Seminar. Specific additional requirements for study in the Biomedical Sciences include, in addition to the above, a suite of new, or modified, courses that will complement traditional study in basic molecular and cellular biology, and biochemistry; these add emphases, for example, in more integrative areas such as genomics, epidemiology, immunology, and animal models. The review panel determined that the necessary courses were in place, or under development, to allow students to successfully meet degree requirements. Although it is not part of our charge to evaluate graduate school-level function, we note that we consider the CHS program perhaps overly course intensive; but, it is so because that is what is expected in the university context.

The program is **administered** by a senior faculty director (0.20 FTE) with adequate staff support for a start-up program (0.5 FTE). The proposed Director, Dr. Luiz Bermudez, has the scientific credentials and college-level leadership position
(Department Head) appropriate to lead such a graduate program. The Director and staff person will also coordinate with the Graduate School, thus garnering additional general staffing support for student recruitment and admission. The review panel suggests that to best ensure the long-term success of the program, especially with respect to sustaining resource commitments, a steering committee be created, consisting of the deans, or high-level dean designee, from each the three cooperating colleges within the Division of Health Sciences (Veterinary Medicine, Pharmacy, and Public Health). The review team met with these deans and also reviewed the statements of commitment from the deans that were included in the proposal. Their commitment is strong, but we believe that formalizing and managing that commitment through a steering committee would best promote the long-term success of the CHS program.

An appropriate suite of assessment mechanisms and tools is described, consistent with best practices in most graduate programs. The student and mentor must establish the thesis advisory committee by the end of the 2nd quarter of study. Subsequently, at least annually both the student and the mentor must provide an annual report to the college graduate program committee for review of progress and meeting benchmarks. Additional assessments include, exit interviews of graduates, surveys of alumni and employers, graduation rates, and time to graduation.

b. The program's alignment with the institution's mission and strategic objectives.

The CHS program is very well aligned with OSU’s mission and strategic objectives. OSU is a comprehensive, doctoral, research university. The CHS program grows naturally out of the merger of three health professions colleges, Vet Med, Pharmacy, and Public Health into a Division of Health Sciences to advance one of three strategic areas of distinction at OSU, Improving Human Health and Wellness. Meeting this OSU strategic objective requires, among other things, “building more holistic and interdisciplinary approaches to health aging, chronic infectious disease control, new drug development, mental health, and disease prevention to enhance the human lifespan, decrease health care costs, and maintain a healthy population. The CHS program emphasis on “One Health” (see http://onehealthinitiative.com/ and http://zoobiquity.com/) and systems and integrative, whole animal function and behavior as animal models of human disease, is well aligned with this strategic university emphasis.

c. The depth and breadth of coverage in terms of faculty availability and expertise, regular course offerings and directed study, and access to and use of support resources within and external to the institution.

See 1.a., above, for more course information, and 2.a. – e., below, for discussion of faculty as regards breadth of coverage with respect to course offerings and faculty availability. As noted elsewhere, faculty enthusiasm for this new program is very high, and there should be no shortage of qualified faculty research to serve as individual student mentors or to provide the effort needed to teach required and elective courses. A broad range of appropriate courses is available, or planned, to meet the course-intensive nature of this degree program. Library, animal vivarium, diagnostic, clinical, and core life science research equipment and special services,
among others, are readily available and should provide adequate infrastructure support resources necessary for student success in the CHS program (more detail below in Section 4).

d. The relationship of this program to undergraduate and other graduate programs at the institution and other institutions in the state, if appropriate. Consider collaborative arrangements, partnerships, interdisciplinary programs, service functions, joint research projects, support programs, etc.

This program meshes well with those undergraduate majors from around the state, and within OSU, that feed into a) life science graduate study and b) health professions education programs in veterinary medicine, pharmacy, and public health, where advanced graduate study (variably MS or PhD, depending on program and student interest) is desired in addition to the professional health science degree (i.e., DVM, PharmD, or MPH). Although not contemplated in the program proposal, the review team encouraged CHS program leadership to consider how they might create stronger, systematic ties to undergraduate programs as “feeders” or “pipelines” that identify undergraduate student interest in comparative health science study, provide appropriate mentoring and undergraduate research experiences, and then facilitate transition to the CHS graduate program. As noted previously, the CHS program also relates very well to the other major health-science related life science graduate programs at OSU, especially the MCB program. These programs have to some extent overlapping faculty, but the program emphases contrast significantly such that students with a more reductionist interest would track toward the MCB program, whereas those with a more health-science, translational and whole organism interest would track toward the CHS program. Both are interdisciplinary programs, but their emphases will serve, and attract, distinct populations of students.

e. The justification in terms of state needs, demand, access, and cost effectiveness (if this program represents System duplication).

In general, market demand in the biomedical sciences is strong, especially in the area of animal models of human disease, or comparative medicine. As a result, the National Center for Advancing Translational Sciences of NIH (formerly National Center for Research Resources, or NCRR) has long-standing programs that invest in a comparative biomedical workforce to meet such demands. Furthermore, for health professionals seeking advanced graduate study to complement their professional degree (DVM, PharmD, MPH), in many cases the proposed CHS program will be the only suitable graduate program alternative. This will especially be the case for veterinary clinical residents who will seek an MS degree to complement their advanced clinical training or PhD degree that will keep them on track into academic positions at veterinary colleges. This latter is an area of concern in terms of workforce – where will the next generation of veterinary academics come from?

The proposed CHS degree program grows naturally out of the strategic plans of OSU, especially those that led to the creation of the Division of Health Sciences. Importantly, the very consciously multi-disciplinary, integrative, whole organism
emphasis of this degree program fills an important role in the state. The academic and health care sectors of Oregon’s economy are strong and, as they are in many states, are drivers of innovation. The other comprehensive research intensive universities in the state, University of Oregon and Oregon Health & Science University do not offer similarly focused degrees. Thus, the proposed CHS program fills an unmet need in the state for an advanced graduate degree program that focuses on comparative biomedicine and whole organism translational research.

f. The probable impact of the program on the department or academic unit, as well as its effect on current programs.

This proposed CHS program replaces an older existing graduate program with a newer program more suitable for meeting student demand in a division that seeks to foster cross-species (animal to human) approaches, and thus does not expand graduate offerings overall. Faculty effort from the discontinued program will be redirected to the proposed new program.

The proposed CHS program does not duplicate existing programs but, rather, is highly complementary, especially to the Molecular and Cell Biology program. If anything, it should enhance the MCB program by attracting additional high quality graduate students who will often share research mentors and some courses, many of whom will have professional health science degrees, to enrich the overall graduate training environment culture and student cohort experience.

Overall, the cooperating academic units across three health-science colleges should benefit from a program that attracts more graduate students, who have different motivations than students attracted to existing program offerings, such as MCB.

g. The program’s major strengths and weaknesses.

**Strengths:**

- Excellent alignment with university and division strategic objectives and mission in the health sciences
- Integrative and systems orientation toward the whole organism and translational biology is complementary to, but not duplicative of, existing life science graduate programs at OSU (especially MCB)
- It has a much-needed and contemporary emphasis on research using animal models of disease to address important human health problems (a “One Health” approach).
- There is strong administrative and faculty support and engagement
- Initial student interest appears to be strong
- Serves the workforce needs of strong bioscience and biomedical sectors in the state and region.

**Weaknesses:**

- The program is very course intensive; it apparently must be this way due to university guidelines but a) this is not the best practice for modern graduate
education in the sciences, where the primary emphasis is on hands-on research training with reduced emphasis on comprehensive book-based knowledge), and b) it makes engagement by clinical house officers (veterinary medical and pharmacy residents) in the program more difficult because it is hard for them to balance clinical duties, research, and heavy course requirements.

- Although a plan for recruiting a diverse student body is presented, it is fairly generic and brief. The reviewers encourage close coordination with the Graduate School to recruit personally at SACNAS (Society for Advancement of Hispanics/Chicanos and Native Americans in Science) and ABRCMS (Annual Biomedical Research Conference for Minority Students), among other means of attracting a diverse applicant pool.
- Program faculty could be better balanced with respect to discipline: 63% have their academic homes in Veterinary Medicine and building a strong cohort of program graduate faculty who have their primary academic home in other colleges will be important to achieve the integrative and multi-disciplinary program goals.

2. Faculty

a. The quality of the faculty in terms of training, experience, research, scholarly contributions, ability to generate external support, stature in the field, and qualifications to serve as graduate faculty.

The reviewers met with a portion of the faculty and reviewed their track records regarding publication, graduate training and funding. We were highly impressed with the faculty involved in this program, all of which currently have significant extramural funding and there is no reason to expect that they will not be able to maintain extramural support throughout their careers. The ability to obtain funding, as demonstrated by this faculty, will be instrumental in maintaining the quality of the program long-term. The moderate to large number of faculty that have committed to this program are high quality with excellent training background and relevant expertise. These faculties has extensive experience that is directly relevant to training in this graduate program and have solid experience training students at the masters and doctoral level, providing high confidence that students will be trained well in this program. It is expected that the quality of the faculty in this program will serve well in attracting high caliber students from the state, nationally and internationally. Several of the faculties in this program already have strong international reputations that will serve particularly well in attracting students and visibility internationally in multiple countries where high quality international students are likely to be recruited into this program and could improve enrollment in this interdisciplinary program and in graduate programs at the university in general. All faculty participants exceed the necessary qualifications to serve as graduate faculty, providing a strong foundation on which to build a strong, high caliber interdisciplinary graduate program.

b. The faculty in terms of size, qualifications for area(s) of specialization offered, and the student body served. Include analysis of program sustainability in light of such factors as upcoming retirements, etc.
Although the size of the faculty is quite large (>40), this size is appropriate for an interdisciplinary program that is diverse, involving multiple colleges, and shows the commitment of the different units to the program. This commitment bodes well for the future of the program, suggesting that is likely to be a large and successful graduate program that becomes important for stimulating multidisciplinary research between the involved colleges at this university.

The faculty involved have expertise in veterinary medicine, pharmacology, public health and engineering with complimentary and synergistic potential that will be important for mentoring and co-mentoring students in the modern competitive translational scientific arena. The faculty have an excellent and appropriate combination of professional and academic degrees, primarily in the veterinary and health areas, which are both critical to the training mission of this program. The students involved will gain unique skills that could not be garnered in a traditional departmental or college graduate program and will enhance their ability to compete in the job market.

The program members span a broad spectrum of junior and senior faculty that will contribute to strengthening and maintaining the program long-term, despite potential retirements over the coming years. This diversity in seniority will be important for this program to maintain its momentum and is seen as a strength of the current faculty makeup.

c. Areas of faculty strength and weakness.

The major strengths of the faculty include their diversity and opportunity to stimulate synergistic interactions both within and outside of the program. The subject area strengths of the faculty in this program include Veterinary Medicine, Public Health, Pharmacy, Animal Sciences, Bioengineering and Chemical Engineering. The complementary expertise of the faculty is somewhat unique nationally, making them more competitive for interdisciplinary project applications that many other groups would not necessarily be able to put together viable teams rapidly enough to enable submission of applications. In addition to their diversity, the faculty display enthusiasm for the program and a strong desire to rigorously mentor graduate students in the subject area of this program. They all have competitive and nationally recognized extramural funding that evidences the success of their research programs. Furthermore, they have all maintained strong publication track-records which will serve to improve recruiting potential, enable continued funding of their programs and enhance the reputation of the institution and the proposed graduate program. The review team met with faculty from the Veterinary Medicine program and were impressed by their commitment to the proposed graduate program.

The review team was unable to gauge the enthusiasm and commitment of faculty groups outside of Veterinary Medicine, because they did not meet with them. However, as evidenced by their provision of material for the application and the interview with respective deans, it appears that they are sufficiently committed,
which will be important for maintenance of the interdisciplinary nature of this program long-term.

The only weakness of the faculty noted by the review team was an overly large percentage (63%) of Veterinary Medicine faculty as compared to the sum of other groups, including Pharmacy, Public Health, Agricultural Sciences and Engineering. Recruitment of additional faculty in other groups will be important to ensure the interdisciplinary nature of this program.

d. Faculty workload, including availability for student advising, research oversight, mentoring, and teaching effectiveness.

The faculty involved in this program have the appropriate expertise to provide valuable interdisciplinary mentoring opportunities for students. The current workload for these faculty appears appropriate to allow them to supervise students during both masters and doctoral research included within the proposed program. All faculty have previously and/or are currently supervising students involved in other graduate programs, which provides high confidence that they will continue to maintain this workload and make themselves available for student advising. Commitment of the faculty to appropriate oversight of students is evidenced by their demonstrated understanding of the required coursework, including ethics, expectations in terms of publications and time to graduation and recruitment. All of these issues were addressed through meeting the faculty, discussions with administrators and review of the proposal for the program.

e. The credentials, involvement of, and reliance upon support faculty from other departments within the institutions, from other institutions, and/or adjunct faculty.

Because this is an interdisciplinary program, none of the faculty involved are actually outside of the program and those included have excellent credentials for graduate mentorship. Currently there are approximately 15 faculty from outside Veterinary Medicine and each contributes valuable interdisciplinary expertise to this program. Each is appropriately involved to allow the program to prosper as an interdisciplinary program. There does not appear to be any reliance on adjunct faculty or faculty at other institutions at this time. As the program grows, there is potential for collaboration and involvement of faculty at the Oregon Health Sciences University and the University of Oregon in Eugene, but these interactions are not necessary for this program to be successful.

3. Need

a. The evidence that there is significant demand for this program.

In general, a strong biomedical and health care sector in Oregon (more below in 3.c.) and the US translates into strong workforce needs, which, in turn, translates into strong student demand for health professions education and, for a subset of those students, strong demand for graduate education to complement health professions education. The clinical residency programs of Pharmacy and Veterinary Medicine
alone will drive significant student demand for graduate training in the comparative health sciences – some at the doctoral level, and significantly at the MS level. Preliminary surveys of demand of other students by program leadership, and the number of unsolicited inquiries from prospective students, also suggest that student demand will be strong.

b. The evidence of sufficient and relevant employment opportunities for graduates of this program.

The 2012-2013 Bureau of Labor Statistics *Occupational Outlook Handbook* describes job outlook in terms of projected percentage growth of employment opportunities in a given sector from 2010-2020, accompanied by a qualitative descriptor in relation to average job growth across all employment sectors. Selected sectors that could be fed by the proposed CHS graduate program are:

- **Medical Scientists**  
  Job outlook = 36% (Much faster than average)

- **Epidemiologists**  
  Job outlook = 24% (Faster than average)

- **Microbiologists**  
  Job outlook = 13% (About as fast as average)

(The general Pharmacy and Veterinary sectors show job outlooks of 36% and 25%, respectively.) With respect to veterinary workforce needs, specifically, which this program will serve significantly, one key finding of the the recent National Academy of Sciences study of *Workforce Needs in Veterinary Medicine (2012)* was that:

> “some sectors [of the veterinary workforce] are struggling to find well-qualified candidates, even when offering high salaries. For example, the industrial sector is facing a shortage of candidates with **advanced training** in topics such as biochemistry, toxicology, or pathology; and veterinary colleges are in need of **research faculty** with the grant-writing skills to leverage funding for their programs.” [our emphases]

Demand can also be inferred from strength of market sectors, which for health care and biomedical science remain strong. For example, Oregon’s health care sector accounts for $23.3 Billion, or ~14%, of the state’s GDP in 2008. ([http://www.oregon.gov/OHA/OHPR/HPB/Workforce/Docs/Final_Econ_OR_HCW_2_11.pdf](http://www.oregon.gov/OHA/OHPR/HPB/Workforce/Docs/Final_Econ_OR_HCW_2_11.pdf)), and should continue to grow, as noted above. Similarly the biotech and lifesciences industries in the state account for. Nationally, a key finding of the Batelle Bio 2012 Industry report noted that “during the 2001 to 2010 period, the U.S. bioscience industry gained jobs, despite job losses in overall U.S. total private sector industry employment” [6.4% growth in bioscience jobs vs. 2.9% decline in all private sector; it was the only “knowledge industry” sector to gain jobs; if one focuses only on the recession period of 2007-2010, sector employment declined 1.4%, the smallest decline of any “knowledge industry” – Oregon faired similarly, overall, and actually grew in the recession period of 2007-2010. A report for the Oregon Bioscience Association in 2009 ([https://oregonbio.org/images/industry_reports_pdf/Non_OBA_Reports/2009%20econ%20impact%20website_final.pdf](https://oregonbio.org/images/industry_reports_pdf/Non_OBA_Reports/2009%20econ%20impact%20website_final.pdf)) mirrors the Battelle findings, showing an 18% growth in economic output to ~$4.1 Billion between 2007 and 2009, with concomitant increases in jobs and personal income of those employed in such jobs.
These are typically high-wage jobs, averaging ~$62,000 per year, or ~55% above the average annual pay of private sector employees in Oregon.

c. The overall need for the program within the institution, the Oregon University System, state and/or region, and nation.

See also 1.e., above. The proposed program is unique with the OUS and, as described above, fills an important niche in an array of contemporary biomedical and life science graduate programs in terms of biomedical workforce preparation, a sector that has strong employment demand as described in 3.b., above.

4. Resources

a. The adequacy of library, computer, laboratory, and other research facilities and equipment; offices; classrooms; support services for the program; and, if relevant, the program's utilization of resources outside the institution (e.g., field sites, laboratories, museums, libraries, and cooperative arrangements with other institutions).

Library Resources: CHS students and faculty will have access to the Veterinary Medicine and OSU Valley Libraries. These libraries have sufficient collections and periodicals to serve the proposed CHS program. In addition, access to books and journals via electronic means or interlibrary loans should provide opportunities for materials not immediately available in the libraries. It is suggested that CHS faculty and students have a mechanism to interact with the libraries about any specific library resources and services peculiar to CHS and how the libraries might meet these needs.

Computer Resources: External reviewers met with the College of Veterinary Medicine IT resources. The CVM computer services appear to be adequate for most CHS needs, although the resources for working with large data sets that may be relevant to some CHS projects was not provided.

Laboratory, Other Research Facilities and Equipment: External reviewers toured CVM research laboratories in Magruder and Dryden Halls. Magruder Hall has large, multi-investigator laboratories which are modern, well-designed and equipped research laboratories suitable for support of the CHS program. Laboratories in Dryden Hall were undergoing renovation and consisted of smaller, individual research laboratories, which, once renovation is complete, should be excellent research space for the CHS program. Laboratory animal facilities will be an integral part of the CHS program; however, the reviewers were not provided a tour of these faculties. The reviewers did learn the laboratory animal facilities are unified for the entire university and housed in a newer, modern laboratory animal facility which is accredited by the Association for Assessment and Accreditation of Laboratory Animal Care.

Offices, Classrooms and Support Services: Reviewers visited classrooms under renovation in Dryden Hall. These had modern classroom electronics and appeared well-designed for teaching purposes. When asked about availability of video-recording for lectures, CVM apparently does not have this capacity which might be
useful for students to access instruction in an interdisciplinary program spread across several locations on and off campus. The offices for students were excellent. These consisted of both desk space in laboratories as well as large, multi-cubicle office space for students in locations convenient for students to laboratory areas. The reviewers were not provided with information on student support services.

Program's Utilization of Resources Outside the Institution: The reviewers were not provided with information on these resources.

b. The proposed budget and any need for new resources to operate the program effectively.
   Where appropriate, review resources available to support graduate students (e.g., fellowships and other scholarships, teaching and research assistantships).

The CHS program, as presented, consists of a single option of Biomedical Sciences. Four categories of students are proposed to be matriculated into this option: 1) clinical residents seeking MS degrees, 2) post-baccalaureate or post-master’s degree holders seeking PhD degrees, 3) combined DVM-PhD students, and 4) INTO students. Of these categories of students, clinical residents and post-bachelor/master students will be supported as GTAs or GRAs. The DVM-PhD students will be supported in a similar fashion to the clinical residents and the INTO students will be supported by governmental fellowships from their home government or personal funds. Financial support of the clinical resident MS students, which will be the largest cohort at 17 to 25 students, is a substantial commitment of institutional resources and is applauded.

c. In terms of national standards, the institution's commitment to the program as demonstrated by the number of faculty relative to workload and student numbers, support for faculty by nonacademic personnel (e.g., support, staff, technicians), financial support for students, and funds for faculty research and professional activities (e.g., conferences, visiting lectures).

In the opinion of the external reviewers, Oregon State University’s commitment to the CHS program is equal to or exceeds the national standard for institutional support of an interdisciplinary program. This support is primarily from the CVM rather than the Graduate School. As new options are added, additional support for option directors and administrative staff will be needed. A plan for this support should be made prior to the approval of the program.

Faculty members are committed to providing advisement and mentoring of CHS students. The ratio of faculty advisors/mentors to students seems appropriate at 1:1.5. Financial support for student stipends appears adequate at or exceeding the NIH pre-doctoral level. Faculty research funding and productivity are good relative to the number of proposed students in the program.

d. Institution leaders' commitment to this program in the long term.

The external reviewers met with the division deans, associate deans, department heads, and graduate program directors. These administrative leaders supported the proposal enthusiastically and saw the potential for development of additional
program options in their schools, particularly in pharmacy and nutrition. In the opinion of the external reviewers, for the proposed program to be interdisciplinary, these and other options will need to be developed prior to the third-year review of the program.

e. The institution's ability to sustain the program in the foreseeable future along with its current and future projected commitments.

Sustainability of interdisciplinary programs is multifactorial and difficult to accurately predict. The Oregon State University units involved appear to be fully committed to sustaining the program for the long term. Success in addition of options to the program and recruitment of students will be primary factors in determining the sustainability of the program.

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