External Review Committee Report:
Analysis & Recommendations

Integrated Biomedical Sciences PhD Program & Tracks

University of Tennessee Health Sciences Center

Memphis, Tennessee

June 30, 2015
Contents

External Review Team Members ....................................................... Page 3
Approach to the IBS Program Review .............................................. Page 3
Overview and External Reviewers’ Perspectives .............................. Page 4
External Team Conclusions ........................................................... Page 4
Program Analysis: Strengths & Weaknesses ..................................... Page 5
Recommendations for IBS Program Competitiveness .......................... Page 6
Background Information: Documents, Data, and Analysis ................... Page 8
(including External Reviewers’ Observations and Opinions)
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External Team’s Approach to the IBS Program Review

- Review materials provided by the IBS Program administration in advance of site visit (LB, RM and LS)

- Conduct on site interviews with Graduate School Dean and Staff, College Associate Deans and IBS Program and Track leadership, faculty and students (RM and LS)

- Conduct on site visits to facilities and assess geographic relationship of UTHSC and St. Jude Children's Research Hospital (RM and LS)

- Review materials provided by the IBS Program administration requested following the site visit (LB, RM and LS)

- Perform independent research related to ISB Program resources at UTHSC in comparison with resources at other Tennessee public institutions and peer institutions. (LB, RM and LS)
Overview and External Reviewers’ Perspectives:

Biomedical Sciences PhD degree programs are the pinnacle of education for future leading scientists and entrepreneurs. The University of Tennessee Health Sciences Center’s Integrated Biomedical Sciences (IBS) PhD Program is the flagship program in this field for the State of Tennessee. As such, graduates from the UTHSC IBS PhD program typically will accept postdoctoral scientist positions in research programs within Tennessee (principally in Memphis) that significantly contribute to the continuing competitive capacity of faculty at UTHSC and senior scientists at St. Jude Children’s Research Hospital (SJCRH) to maintain a stable level of research funding from the National Institutes of Health. Beyond specialized training as postdoctoral scientists, such graduates of this program form a cadre of future leaders in science education, discovery research, applied research and as entrepreneurs of biotechnology enterprises for the State of Tennessee.

Collectively the external review team subscribes to the perspective that the faculty and mentors associated with UTHSC IBS PhD program should focus on training its graduate students with the ability to remain competitive, innovative, resourceful, and adaptable since the careers they will enter upon graduation may not yet exist, and the specific skills, methods and techniques they will use in their careers may not have been developed. In addition we believe that effective written and oral communication capacity and the ability to work within and effectively manage a diverse future workforce are critical to successful leadership careers in biomedical sciences.

The External Team Concludes that Program Investment is Required to:

- Sustain certain existing tracks (Physiology & Pharmacology)
- Enhance domestic student recruitment to improve the racial diversity balance, including underrepresented minorities
- Expand a summer undergraduate research training and orientation to the IBS PhD degree program and research tracks
- Extend stipend support for all IBS students for up to 2 years; i.e., until completion of required courses and passed qualifying examination (F31 proposal based)
- Track graduates for at least 10 years following their graduation
- Increase central administrative staff to provide a more effective online admissions process, active recruitment, graduate tracking and support for other administrative functions

Attention is Required to:

- Continue to Increase the number of applications for extramural pre-doctoral training awards, and develop programs to boost the success rate of these applications
- Implement adoption of the IDP (individual development plan, http://myidp.sciencecareers.org/) by all tracks and all students, IDPs provide a method of continuous program improvement by documenting interactions, identify career goals, establish and document benchmarks of student progress, promote timely degree completion, and force the regular participation of student, research mentor, and an IBS representative in a rigorous career development program for each student.
Program Analysis by the External Team

Program Strengths:
- IBS Program Director (Dr. Rennolds Ostrom) commitment to students and capacity to direct the program, effective working relationship with track directors, and with VP & Director Academic Programs in Biomedical Sciences at SJCRH (Dr. Gerard Zambetti).
- Effective and supportive SJCRH Director of Academic Affairs (Dr. Gerard Zambetti) with excellent communication and collaboration with the IBS Program Director at UTHSC
- UTHSC faculty and SJCRH researchers, who are well integrated into the Program
- IBS program students, who are energetic and enthusiastic, and whose engagement in professional and career development is high.
- Overall quality of admitted students; their academic preparedness metrics (GPA, GRE, TOEFL) are at or above metrics advertised by the IBS PhD program.

Program Weaknesses:
- Geographic barriers exist at and between UTHSC and SJCRH
- SJCRH mentors are primarily aligned with only one (CDB) of the five IBS program research tracks.
- Minimal graduate school, IBS program and research track or department support exists for pipeline (summer and academic year) programs for early IBS PhD program candidate identification and recruitment of applicants to the IBS program
- Undergraduate and minority partner institution arrangements are limited or do not exist, despite many opportunities within the State of Tennessee
- The IBS graduate program recruitment strategy is primarily passive, and has few if any active elements
- Central staffing is insufficient to support the IBS PhD program administration, tracking of graduates, and recruitment activities
- Graduates are not tracked beyond first year following PhD completion
- Horizontal (cross-track) and vertical (admission to graduation) integrative experiences are absent or are not a program focus for enrolled students
- Potentially non-competitive stipends compared to peer institutions. Also, within the IBS graduate program stipends paid by UTHSC are of insufficient duration and as a result limit the potential pool of mentors.
Recommendations for Sustained and Enhanced IBS Program Competitiveness:

The external review team make the following recommendations to sustain and enhance the current Integrated Biomedical Science PhD Program at the University of Tennessee Health Sciences Center in collaboration with St. Jude Children’s Research Hospital, Memphis, Tennessee.

1. Develop and Implement An Active Student Recruitment Plan
   - Develop partnerships with undergraduate institutions in Tennessee and contiguous states (MS, GA, AL, AR, NC, KY).
   - Develop partnerships with in-state and nearby minority serving institutions.
   - Expand the summer undergraduate research fellowship program.
   - Develop an active recruitment strategy for domestic applicants.
   - Address diversity imbalances within the Program.

2. Review and Revise Stipends and Funding Incentives
   - Provide stipend support for all students for first 2 years, until required research track curriculum and qualifying examination is completed.
   - The new and innovative incentives program, designed to reward students who submit pre-doctoral fellowships, is an excellent idea and should be continued and expanded.
   - Evaluate value of stipend levels to assure competitiveness with peer institution programs and assure there is the same stipend support across all 5 research tracks.

3. Develop Cross-cutting Curriculum Elements
   - Establish common “longitudinal” curriculum experience from admission to graduation.
   - Institute “horizontal” cross-track student/faculty experiences beyond the 2nd year
   - Implement a multi-year grant-writing workshop, in which faculty and post-doctoral Fellows would oversee students in developing drafts for submission of pre-doctoral proposals and then critiquing each other’s proposals. The workshop should be able to accomplish this goal in just a few meetings (e.g., 3-4 meetings of 1-2 hours each) each year. Working together would help integrate the classes and would also improve proposal submission and success rates.

4. Enhance Selected Tracks with Existing Faculty
   - Expand faculty in pharmacology & physiology tracks to sustain a critical mass of students, or combine these 2 tracks. The SJCRH academic programs director identified the potential to add SJCRH researchers to faculty in the pharmacology track.
   - Faculty in all UTHSC departments with active funded research programs may be candidates to expand mentor pool for the physiology track
   - Faculty mentor pool expansion in these two department-constrained tracks would permit student recruitment to permit creation of a critical mass of students.

5. Implement a Career Development Program for Students
   - Expand orientation to diverse biomedical careers for future leadership in Tennessee and in the region
   - Design and implement a new graduate course focused on careers in science education, discovery research, applied research, and entrepreneurship with a focus on the State of Tennessee
   - Explore a partnership with the State of Tennessee’s Department of Labor and Workforce Development (http://www.state.tn.us/labor-wfd/) that could potentially underwrite this course.
6. Track and Network with Graduates in Diverse Careers
   • Use social media (LinkedIn, Facebook, etc.) to build a record of previous graduates and their career pathways and to create a database of external career mentors for current IBS PhD program students.
   • Invite former graduates as external speakers on careers

7. Increase Central Support for Program Staff Unmet Needs of the IBMS PhD program
   • Increase and fund central administrative support for the IBS Program by adding full-time staff that would provide a full time program assistant to the program director, and sufficient additional staff support provide active focused support for active recruitment of students to the IBS program, expanded summer undergraduate research training programs, and maintain an up-to-date alumni database of graduates for 10 years following graduation.

8. Develop and Implement a Continuous Program Improvement (CPI) Plan
   • Adopt the IDP (individual development plan, http://myidp.sciencecareers.org/) to encourage student commitment to career planning and timely progress to degree completion as supported by research mentor(s)
   • Promote student feedback to identify program weaknesses at monthly cross-track student lunches with Program Director
   • Establish quarterly Track Director and Program Director meetings to monitor student progress to degree completion
   • Explore cross-track synergistic opportunities for student training
   • Establish a mentor review and “mentoring the mentor” process
   • Establish a periodic review and revision of curriculum and courses for all research tracks and for common core curriculum.
Background

2015 Self-Study Report - Strengths, Weaknesses, and Recommendations:
The external review team has evaluated the Cost/Benefits of the Program as identified on p 23-24 of the 2015 IBS Graduate Program Self-Study Report and compared it with information collected by the team before, during and after the on site visit on May 10-12, 2015.

IBS Graduate Program Strengths:
Among the program’s strengths are several items that have not been confirmed by the external review team. These include metrics on faculty peer-reviewed publications, faculty member’ research experience, etc., and interdisciplinary collaborations as evidenced by publications and grant applications. Publications of UTHSC faculty are searchable on a database maintained by its library at: http://library.uthsc.edu/eresources/uthsc-publications/. The external team was shown various faculty offices, but did not confirm that all IBS Graduate program faculty have active research offices at the participating institutions UTHSC and SJCRH.

[Reviewers’ Observation: Not having these data readily available makes it more difficult for faculty to submit training grants, and for students to document within their own individual pre-doctoral grant the success of their Program. This point aside, the external team is convinced to a reasonable degree of certainty that a good match exists between student interest and faculty expertise for 95+% of the enrolled students and we concur that the “apprenticeship model” applied at UTHSC in the IBS graduate program is a good method for preparing the “next generation of researchers” (and educators, and entrepreneurs, etc.).]

The external review team was unable to confirm the self-study statement that “the IBS program graduates 18 to 20 PhD students annually”; the data on p 20 of the 2015 Self-Study Report indicate that between 14 and 21 students were awarded the PhD degree by the IBS program between 2010 and 2014, a minor inconsistency. Of the total of 87 awarded degrees during this 5-year period only 13 were Tennessee residents (15%), 57% were women, and the number of international students was not reported.

Regarding the perspective that “diversity” is an IBS program strength, the external review team observed from the 2015 Self-Study Report (p 19) that for the period from 2008-2014 the IBS program enrolled 57% Caucasian, 5% African-American, 4% Hispanic, and 32% Asian students. The IBS student demographic for Caucasian and African-American races is significantly lower than the corresponding demographics of Tennessee according to the latest US Census data: 75% Caucasian, 17% African-American, 5% Hispanic, and 2% Asian. For the entire USA the demographics are 63% Caucasian, 13% African-American, 17% Hispanic, and 5% Asian.

[Reviewers’ Analysis: Using this census data for Tennessee and the USA, the external team observes that while the IBS graduate program has a diverse enrollment, it is overweight in its Asian demographic, underweight in Caucasian, significantly underweight in African-American, and appropriately weighted in Hispanics.]

IBS Graduate Program Weaknesses:
The 2015 Self-Study Report identifies 2 weaknesses: (1) a decline in externally (NIH) funded faculty (translating to a decreased number of mentors for IBS PhD students), and (2) a flawed central administration application processing system adding significant administrative burdens to the program director, track directors and department personnel who review applications and make admission decisions.
[Reviewers’ Opinion: The external review team concurs that NIH funding, including numbers of awards and awardees, has declined - more so at UTHSC than at SJCRH. Institutional changes at UTHSC, leading to increased recruitment and retention of actively funded faculty will be required to stem the downward trend that adversely impacts the IBS graduate program. Such steps should be directed at increasing the national rankings of UTHSC disciplines in NIH awards. The external review team was informed that the onerous online admissions portal was in the process of being improved, but that applications for 2015 admission had been adversely affected.]

Program Description:
The following is a direct excerpt from the IBD Program website.

“The Ph.D. program in Integrated Biomedical Sciences (IBSP) is an interdisciplinary, research-oriented graduate program in which students train in faculty laboratories at the University of Tennessee Health Science Center, St. Jude Children’s Research Hospital, LeBonheur Children’s Hospital, and the Veteran Affairs Medical Center, among others. Students who would like to train in any one of our five research tracks should apply to the IBSP, and will then have the option of considering multiple tracks or directly entering a specific track.
The IBSP offers exceptional features:
• Over 150 participating faculty members from UTHSC, St. Jude Children's Research Hospital, and the Veterans Affairs Medical Center
• Five different tracks representing the best of contemporary biology
• Flexibility: students may select from laboratories in any of the tracks to identify a Research Advisor and are not limited by departmental barriers found in traditional graduate programs
• NIH-funded training grant for underrepresented minority students in bacterial pathogenesis”

Research Track Descriptions:
The following descriptions are direct excerpts from the IBS Program’s website.

“The UTHSC Biomedical Sciences Graduate Programs offer Doctor of Philosophy (Ph.D.) and Masters (M.S.) degrees, granted through the UTHSC College of Graduate Health Sciences, in four separate areas; Integrated Biomedical Sciences (Ph.D. degrees in 5 emphasis tracks), Epidemiology (Certificate and M.S. degree), Biomedical Engineering (M.S and Ph.D. degrees), and Pharmacology (MS degree).”

“The Integrated Biomedical Sciences (IBS) Program is run through the UTHSC College of Medicine Basic Science Departments and our partners at St. Jude Children’s Research Hospital and the Memphis Veterans Affairs Medical Center.”

“The IBS Program has five separate Doctor of Philosophy tracks: Cancer and Developmental Biology; Cell Biology and Physiology; Microbiology, Immunology, and Biochemistry; Molecular and Systems Pharmacology; and Neuroscience.”

Track titles in the IPBS PhD program were most recently reviewed and tracks were revised or renamed in 2011 for improved alignment with faculty and departments as follows:
• Cancer and Developmental Biology (CBD, no changes) aligned with and administered by the UTHSC Department of Pathology. The track has a diverse group of research faculty with appointments in 11 different departments both at the University of Tennessee Health Science Center and St. Jude Children’s Research Hospital. The track director is Dr. Tiffany Seagroves (UTHSC). The co-director is Dr. Leta Nutt (SJCRH).
• **Cell Biology and Physiology** (CBP, formerly Molecular and Cellular Systems Physiology – MSCP), formerly Cell Biology and Biochemistry - CBB) aligned with the UTHSC Department of Physiology. Faculty members under this program are involved in cutting-edge research on diverse topics, including cardiovascular, gastrointestinal, respiratory, neurodegenerative and hematopoietic diseases. The **track director** is Dr. Kristen M.S. O’Connell.

• **Genetics** (a UTHSC legacy track; only 2 current students are enrolled).

  [Reviewers’ Opinion: Students seeking a genetics PhD in Tennessee would be advised to consider The Graduate School of Genome Science and Technology (GST, http://gst.tennessee.edu/); a Life Science graduate program at the University of Tennessee at Knoxville (UTK). GST spans two distinct research environments—the University of Tennessee, Knoxville, (UTK) and Oak Ridge National Laboratory (ORNL). The program is enriched by the different research philosophies encountered at a University, emphasizing autonomy, and at a National Lab, emphasizing team effort.]

• **Microbiology, Immunology and Biochemistry** (MIB, formerly Microbiology Pathology, Immunology and Inflammation – MPII) aligned with the UTHSC Department of Microbiology, Immunology and Biochemistry. The MIB track has 35 faculty with active research programs spanning a wide range of research interests, including host-pathogen interactions, mechanisms governing innate and acquired immune responses, vaccine and therapeutic vector development, utilization of genomics/bioinformatics to study human disease, and research into the genetics, and biochemical and/or cell biological mechanisms of eukaryotic or prokaryotic organisms. The **track director** is Dr. David R. Nelson.

• **Molecular and Systems Pharmacology** (MSP, formerly Molecular Therapeutics and Cell Signaling – MTCS) aligned with the UTHSC Department of Pharmacology. The Molecular and Systems Pharmacology Track provides broad training in pharmacology, molecular biology, and cell signaling. The research interests of the faculty in the molecular therapeutic track include neuroparmacology, behavioral neuroscience, cancer pharmacology and drug development, cardiovascular pharmacology, and cell signaling and the regulation of gene expression. The **track director** is Dr. Fang Liao.

• **Neuroscience** (NEU, unchanged) aligned with the UTHSC Department of Anatomy and Neurobiology. Track is composed of 43 faculty from multiple departments at UTHSC and St. Jude Children's Research Hospital who are actively involved in neuroscience research. The **track co-directors** are Dr. Joseph Callaway (UTHSC) and Dr. Jian Zuo (SJCRH).

**Participating Institutions: Number of IBS graduate faculty and students:**
According to the IBS Director, there is no straightforward way of providing a breakdown of UTHSC, LeBonheur and the VA faculty since all are UTHSC faculty with secondary affiliations with these other institutions. For example, a member of the pharmacology department is a UTHSC faculty and has a basic science lab at UTHSC but practices medicine and has clinical lab at the VA. How should he be counted? Another faculty member has a VA merit award and a VA appointment, but his lab is at UTHSC. In reality, all these investigators are UTHSC faculty first and foremost (especially when considering their basic research efforts.

As with many academic medical centers that have faculty structures similar to those at UTHSC, where faculty may identify several geographic affiliations (e.g., LeBonheur Children’s Hospital, Veteran Affairs Medical Centers), and whereas students may utilize resources or have multi-site mentors, it is difficult to assign specific mentors to particular organizations or geographic sites within the UTHSC affiliated institutions. Consequently,
the IBS program does not maintain a record of such program faculty affiliations other than identifying faculty as being at UTHSC or at SJCRH.

**Program & Track Administration:**
The IBS program is administered within the UTHSC Graduate School (Dean, Dr. Donald Thomason) with part-time administrative staff support (one person, ~60%) for the IBS Program Director (Dr. Renolds Ostrom, Pharmacology). The five tracks are directed by faculty within departments at UTHSC and in 2 instances co-directed by research scientists at SJCRH. The following individuals are directors or co-directors of the IBS program research tracks.

- **Cancer and Developmental Biology (CBD): Track director** - Dr. Tiffany Seagroves (UTHSC, Pathology). **Track co-director** - Dr. Leta Nutt (SJCRH).
- **Cell Biology and Physiology (CBP): Track director** - Dr. Kristen M.S. O’Connell
- **Microbiology, Immunology and Biochemistry (MIB): Track director** - Dr. David R. Nelson (UTHSC, Microbiology, Immunology and Biochemistry).
- **Molecular and Systems Pharmacology (MSP): Track director** - Dr. Fang Liao (UTHSC, Physiology).
- **Neuroscience (NEU): Track co-directors** are Dr. Joseph Callaway (UTHSC, Anatomy and Neurobiology) and Dr. Jian Zuo (SJCRH).

**Program and Track Faculty:** “Over 150 participating faculty members from UTHSC, SJCRH, and the Veterans Affairs Medical Center.”

- Overall the Integrated Biomedical Sciences PhD Program lists 247 graduate faculty, 174 of whom are geographically located at UTHSC and affiliated institutions and 73 are geographically located at SJCRH. Faculty may opt to align with one or more of the five PhD research tracks within the overall program. The tracks are administered within departments and align generally with the focus and mission of the departments.
- These data are from the IBS Program faculty database, which includes all credentialed faculty who serve as committee members and as mentors. These numbers are much bigger than those that serve as mentors in each of the five research tracks.
- **Active 2015 Mentors or Co-mentors of 83 students in the Five Research Tracks;**
  - Cancer & Developmental Biology (CDB): 35; plus 10-12 new SJCRH faculty in approval process
  - Cellular and Biochemical Physiology (CBP): 18
  - Microbiology, Immunology, and Biochemistry (MIB): 58
  - Molecular and Systems Pharmacology (MSP): 20
  - Neuroscience (NEU): 45
- **Any future expansion in the Physiology (CBP) research track faculty to assure critical mass of mentor options for PhD students would surely come from existing or new UTHSC faculty with appropriate scientific research programs in the various departments including physiology.**
- **Any future expansion of the Pharmacology (MSP) research track faculty could occur by two means: recruitment of new faculty in pharmacology at UTHSC, and identification of SJCRH faculty with relevant research programs. Such an effort could lead to a modest overall increase in number of pharmacology track faculty and potential mentors, as some SJCRH faculty may already be participating in a different research track.**

*Reviewers’ Observations: Regarding the Physiology Track: During the site visit, the external team received no sense that the leadership of the Physiology Track was exploring an expansion of its faculty or PhD student enrollment. Regarding the Pharmacology Track: Also during the site visit, the external team was informed by Dr. Gerard Zambetti, Director of*
Academic Programs at SJCRH, that such faculty exist at SJCRH should expansion be needed to support a critical mass of student in the MSP research track. The external team did not learn of an explicit interest from the UTHSC MSP track director or department chair of a faculty expansion for the MSP research track that would include SJCRH faculty.

Extramural Resources Support Faculty Research and Supporting Student Training:
The published NIH funding records for UTHSC and SJCRH from 2008 to 2014 reveal the following:

- UTHSC funding total has declined from $36.9M to $31.9M, with an average award increasing from $293,000 in 2008 to $329,500 in 2014. During this period the number of awards to UTHSC faculty investigators has steadily fallen from 126 in 2008 to 97 in 2014.
- Over the same timeframe SJCRH funding has increased from $65.5M to $77.2M, with the average award increasing from $744,000 in 2008 to $848,300 in 2014. During this period the number of awards to SJCRH investigators rose from 88 in 2008 to 110 in 2012 and subsequently fell to 91 in 2014.
- Current grant dollars from all sources in mentor labs by institution – FY2014 (last complete fiscal year) - little anticipated change for FY2015:
  - UTHSC- 55 credentialed IBS graduate faculty with $28.5M direct costs
  - SJCRH – 46 credentialed IBS graduate faculty with $63.1M direct costs


<table>
<thead>
<tr>
<th>Discipline</th>
<th>UTHSC</th>
<th>VU</th>
<th>ETSU</th>
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<td>#4</td>
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<td>NR</td>
<td>#1</td>
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<tr>
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* NR = not ranked; UTHSC = University of Tennessee Heath Sciences Center; VU = Vanderbilt University; ETSU = East Tennessee State University

[Reviewers’ Analysis: Among the ranked UTHSC disciplines (aligned with departments administering the research tracks of the IBSP) in NIH funding for 2014 Physiology was at the 19th percentile (well above the median); whereas Anatomy & Cell Biology was at the 56th percentile (just below the median); Pharmacology was at the 60th percentile, Pathology was at the 76th percentile; and Microbiology was at the 86th percentile. Neuroscience at UTHSC was not ranked. [Note: SJCRH awards were not included in the rankings nor were these awards included in those reported for UTHSC.]
**Student Enrollment by Track.**
Current number of IBS (post 2011)/IPBS (pre 2011) students enrolled as of June 1, 2015: 83 (61=IBS* + 22=IPBS**)  

<table>
<thead>
<tr>
<th>Track:</th>
<th>CDB</th>
<th>CBP/CBB/MSCP</th>
<th>MIB/MPII</th>
<th>MSP/MTCS</th>
<th>NEU</th>
<th>GEN</th>
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<td>5</td>
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**Student Retention & Degrees Conferred**  
--- | --- | --- | --- | --- | --- | --- | --- |
# Withdrew: | 1   | 1   | 3   | 0   | 3   | 2   | 1   |
# Transferred: | 0   | 0   | 2   | 3   | 1   | 0   | 1   |
# Graduated with MS degree: | 0   | 0   | 0   | 3   | 0   | 2   | 3   |
# Graduated with PhD degree: | 0   | 0   | 0   | 0   | 2   | 11  | 12  |
# Remaining Enrolled: | 20  | 19  | 10  | 13  | 16  | 4   | 0   |

**Anticipated 2015-2016 Admissions**  
- Expected number of prospective students to be recruited for 2015-2016: 20  
- Number of faculty currently mentoring an IBS/IPBS student: 83 as of June 1, 2015.  
- Number of new mentors anticipated in 2015-2016: at least 20 for linkage to anticipated new students, in addition to mentors who are continuing for the 83 current students.

**Postdoctoral Positions in Mentor Laboratories**  
- In 2014-2015, 16 UTHSC faculty have both an IBS PhD student and one or more postdocs in their laboratory. There are a total of 27 postdocs in these 16 faculty labs.  
- Dr. Gerard (Gerry) Zambetti, Director of Academic Programs at SJCRH provided a list of 27 faculty/scientists mentoring UTHSC IBS Program PhD students. There are a total of 102 current postdoctoral fellows in these 27 research labs.

**[Reviewers’ Opinion: The continued enrollment of one student in the 9th year is a concern, and must be addressed. Postdoctoral positions are typically held for 4 to 6 years. On this basis, there would be expected to be 2 to 4 postdoctoral vacancies among UTHSC mentors each year, and perhaps as many as 10 vacancies among SJCRH mentors each year. This calculation assumes that each mentor’s research program funding is continuous. This vacancy rate is more than sufficient to absorb the average of 2 graduates per year (12 total) from 2009-2014 who secured postdoctoral positions with UTHSC mentors, and the average of 3 graduates per year (18 total) who secured postdoctoral positions with SJCRH mentors.]**
Tracking Graduates:
The IBS administration currently documents the first position accepted by PhD students following graduation. However, once a student has left the University, there is no follow-up tracking. Updated information comes only from the PhD mentor, and this occurs in only a minority of instances.

[Reviewers’ Opinion: The fact that students are not tracked beyond their first appointment is a significant lost opportunity. It is not currently possible for the program administration to ascertain how many of the PhD graduates from the UTHSC IBS program (or from the preceding IPBS PhD Program) have continued careers in science education, discovery or applied research, government laboratories, private sector biotechnology or pharmaceuticals that contribute to the biomedical leadership workforce for the nation or for the State of Tennessee. This puts the Program at a disadvantage when competing for federal grants to support students. Institutional training grants require this information, and individual fellowships are greatly advantaged by including this information in the section that describes the student’s program. Not tracking graduates also deprives the State of information regarding the use to which its funds are being put. The extent to which graduates remain in the State and contribute to economic and educational development are crucial data that should be of interest to state officials and legislators.]

In the 2015 self-study report (p 45-48), 41% (n=44) of the 107 IBS/IPBS PhD program graduates from 2009-2014 secured their first position in the State of Tennessee. Nearly fifty percent of these graduates found postdoctoral positions in Memphis; 10 entered postdoctoral scientist positions at UTHSC and 11 took postdoctoral positions at St. Jude Children’s Research Hospital. Four entered postdoctoral training at Vanderbilt University in Nashville. Still others chose a variety of positions within Tennessee in:

- **Education (all levels)**
  - [science teacher (1), lecturer at UTK (1), instructor at community college (1), assistant professor at UTHSC (2), cancer education outreach program coordinator (1)],
- **Research** [research assistant (1), research technologist (1), research data analyst (1), medical sequencing scientist (1)],
- **Pharmaceuticals/medical devices/biotech**
  - [scientific/pharmaceutical communications consultant (1), regulatory affairs specialist for medical devices (1), project manager at biotech (1)], and
- **Entrepreneurship**
  - [website editor (1)].

Twelve graduates (11%) accepted postdoctoral positions in one of the contiguous states to Tennessee: Georgia (4), Mississippi (2), Alabama (2), North Carolina (2), Arkansas (1), Kentucky (1). Six graduates (5%) from the IBS program between 2009 and 2014 returned to their home countries upon graduation to pursue careers in higher education; Egypt (2), Belgium (1), Korea (1), Japan (1), and Bahamas (1). The remainder (except for 4 that were undecided at the time of graduation) found postdoctoral positions from Massachusetts to California and from Texas to Minnesota.

[Reviewers’ Opinion: The current positions of graduates (p 45-48, 2015 Self-Study report) suggest that few (15%) have advanced beyond postdoctoral training since graduation; 2009 = 3/15; 2010 = 2/19; 2011 = 4/15; 2012 = 4/21; 2013 = 2/21; 1024 = 1/16. All are in early stages of their respective careers. The IBS program has limited information on what students have done after their initial postgraduate position (which is captured at the exit interview report). The IBS administration acknowledges that this program weakness stems from insufficient administrative support.]
“Graduate productivity and leadership roles” is identified as one of the “program strengths” on p24 of the 2015 Self-Study report. This “productivity and leadership” is not adequately documented in the report. The IBS administration understands that this is just a qualitative assessment of the success IBS PhD graduates’ success early in their careers. The graduates for whom more than just their initial post-graduate position is known to the IBS program administration are reported to show high rates of productivity and frequently assume leadership roles in their next career steps. However, no substantive documentation to support this opinion was provided to the reviewers.

**IBS Ph.D. Program Common Curriculum:**

**Common (Core) Curriculum for all IBS Program students:**
- All entering (first year) students enroll in a *one-semester graduate seminar*, either IP810 (directed by the IBS Program Director, Dr. Rennolds Ostrom) or ANAT810 (directed by a neuroscience track faculty member). Students also must be enrolled in a *journal club course for the first two years*.
- All students complete a *core curriculum (within each research track)* of nine credit hours followed by a minimum of six elective credit hours, but *biostatistics and ethics are the only courses required of all students*. The remaining core and elective courses depend upon the student’s academic background and research interests, and a list of pertinent course offerings can be found at each track’s website.

Example transcripts of one student in each of the 5 research tracks CDB, CBP, MIB, MTCS/MSP, NEU) within the IBS/IPBS PhD program revealed that all complied with the required graduate seminar, and ethics (Integrity-Conduct of Scientific Research) requirements, and four of the five complied with the statistics requirement.

[Reviewers’ Analysis: The requirement that all IBS program students are required to take biostatistics and ethics is not consistently included in the track curricula descriptions. Only the CBD track lists ethics and biostatistics as requirements; MIB, MSP and NEU tracks list only biostatistics as a requirement and are mute on ethics; and CBP lists both ethics and biostatistics as electives; not requirements.]

**Track Curricula:**
- After completing laboratory rotations in the first year, students select their research advisor and begin their dissertation research.
- During the second year, students select their dissertation committee of five faculty members who can best guide them through their graduate research.
- Also, during the second or third year, students will complete an admission-to-candidacy exam, the format of which depends upon the research track and is described at each track’s website.
- All that remains is a defense of the student’s dissertation following the research phase of his/her training.

**Curricula (course titles, credit hrs) for Students in each Research Track:**

- **Cancer and Developmental Biology (CDB):** Required (Core) Curriculum - Biology (3), Molecular Biology (3), Biochemistry (3), Cell Signaling (3), Seminar for CDB track students (1), Seminar for all IBS students (1), Molecular Biology of Cancer (3), Statistics (online, 2h), Ethics (1), Special Topics: Science as a Profession (1), Dissertation Research (variable). To be considered full-time, a student must be enrolled in at least 9h of courses (including dissertation research) per semester.

- **Cell Biology and Physiology (CBP):** Required (Core) Curriculum - Systems


- Neuroscience (NEU): Required (Core) Curriculum – Functional Neuroanatomy (3) plus any two of the following – Cellular Neuroscience (3), Behavioral Neuroscience (3), and Developmental and Molecular Neurobiology (3), and Statistics (2), Neuroscience Seminar (1, every semester), Special Topics (1, first four semesters), Neuroscience Symposium (1, every Spring semester). Electives - any additional 6 credit hours (not including seminar/symposium type classes).

[Reviewers’ Opinion: From the track curriculum descriptions is appears that students in CDB, CBP, and MIB and MSP tracks must take Biochemistry; and students in CDB, CBP and MIB tracks must take Molecular Biology. Beyond these courses, students in any of the research tracks may choose elective courses in which they come in contact with students from more than one track. The curriculum for NEU students is an exception with few, if any, courses likely to be selected by students in other research tracks.]

Program Advertising & Applicant Recruitment Activities:
The UTHSC efforts to promote the IBS Program to prospective applicants appears to be more passive than active, relying on student searches of Internet website results, word of mouth by current students, and by those seeking a biomedical sciences PhD in Memphis. SRCRH promotes the entire IBS program when attending postdoc recruiting venues. Examples of website results from Internet searches performed by the external committee seeking “biomedical sciences graduate programs in Tennessee” easily identify the IBS program among the first listed websites.

Student Applicant Recruitment Activity: Summer Programs for Undergraduates
Exploring PhD options:
- ASPET SURF Program was suspended in 2013, after only 3 years and despite apparent success, due to lack of institutional support and lack of housing options
- UTHSC offers a Summer Research Scholars program that is funded by CGHS. It accepts 10-12 undergrad students each year and places them with UT faculty for summer research.
- No URM summer research careers program exists.
• A specialized training program in bacterial pathogenesis has two spots for underrepresented minorities training within the MIB track of the ISBP

[Reviewers’ Opinion: The IBS Program, with support from the Graduate School, SJCRH, and UTHSC colleges should provide sufficient support (using both internal and external funding sources) for a robust summer undergraduate research training program as to increase exposure to its PhD programs so as to generate an increased applicant pool of domestic student and student form minority serving institutions.]

Admissions Criteria:
Admission criteria to the IBS PhD program are published on its website as follows: “The minimum requirements for admission are a bachelor’s degree with a documented grade point average of 3.0. In addition, three letters of recommendation and official scores on the General Test of the Graduate Record Examination (GRE) must be submitted. A minimum combined score of 1,000 (old scale) or 300 (new scale) is required on the verbal and quantitative sections of the GRE. To be competitive, international applicants should have a GRE score above 1,200 (old scale) or 320 (new scale) and must also demonstrate proficiency in English by a TOEFL score above 213/79 on the computer-based exam.”

The admissions data in the 2015 Self-Study Report confirm that the overall admission metrics for GPA and GRE of all admitted students have been met or exceeded from 2008-2014. However, no breakdown for international students’ GRE or TOEFL scores is provided.

The IBS Program Director (Dr. R. Ostrom) provided the following information after the site visit. The breakdown of international vs. domestic student GRE and GPA for matriculated students in 2014-2015, with data since 2012 using the new GRE scores scale yielded the following:

| International Students: | GPA = 3.68 | GRE = 318 |
| Domestic Students: | GPA = 3.51 | GRE = 311 |

The breakdown of “In State” (i.e., TN) vs “Out of State” (i.e., rest of USA) for the same matriculate cohort yielded the following metrics:

| In State (TN): | GPA = 3.59 | GRE = 311 |
| Out of State (USA): | GPA = 3.48 | GRE = 311 |

The IBS Program does make occasional exceptions to the minimum admissions requirements in cases where other qualifications of the applicant are very strong. Exceptions are not made to more than one of these minimum requirements.

Retention of Admitted Students:
From 2008-2014 a total of 15 students withdrew from the PhD program; 15% (6 of 39 total) of Tennessee residents withdrew, and 9% (9 of 102 total) out-of-state students withdrew.

[Reviewers’ Opinion: The retention of Tennessee students appears to require additional focus by the program and track directors; the root cause should be identified and redressed during the admission selection process, the first year experience, the mentor matching process, and the research mentoring process. Assignment of a “pre-thesis” advisor and creation of a “big sister-big brother” peer mentoring system could produce increases in retention and eventual graduation of Tennessee residents.]
Mentoring Process:
Dean Donald Thomason presented the 2015-2018 Strategic Plan to the review team. The Plan, adopted by the Graduate Studies Council on April 21, 2015, intends to promote education and research training to advance the health sciences through scientific discovery. During the site visit the reviewer team was informed by Dean Donald Thomason that the UTHSC College of Graduate Health Sciences (Graduate School) had recently created and launched a program to develop productive and effective faculty and postdoctoral scientists for the purposes of fostering and rewarding excellence in teaching and research, developing effective career mentors and advisors, developing grantsmanship, fostering inter-professional and interdisciplinary collaboration across diverse programs, providing professional skills and career development, and enhancing the postdoctoral applicant pool.

Monitoring Progress to Degree Completion:
Student progress is monitored by mentors and research advisors and periodically reviewed by the track directors or co-directors, and advisory faculty teams. Reports are provided to the IBS program director at least once each year and a staff assistant (with fractional effort assigned to the IBS program) manages the documentation.

Professional Development Program (Preparing for Diverse Careers):
The new strategic plan (2015-2018) includes approaches to preparing students for diverse careers, orientation to post-PhD careers, next step planning for current PhD students, and may utilize former graduates to inform current student and faculty of opportunities and decision-making in shaping their own career pathways.

[Reviewers’ Opinion: We strongly encourage the Dean of the College of Graduate Health Sciences and the IBS PhD Program and Research Track directors to embrace, support and contribute to the new initiatives in the Strategic plan, among which are goals to (1) recruit, educate, and graduate successful scientists and research professions, (2) enhance the impact of research, (3) develop productive and effective faculty and post-docs, and (4) ensure sufficient resources are allocated to meet strategic priorities.]