Dear Dr. Leshner:

The Federation of American Societies for Experimental Biology (FASEB) thanks the Committee for the opportunity to comment on the core tenets of graduate training programs. Comprising 31 constituent societies with over 130,000 members in the biological and biomedical sciences, FASEB supports the goal of strengthening graduate STEM education to better prepare students for productive careers. Although it is clear that master’s degree programs offer important opportunities for trainees, the responses provided below are directed towards the core educational elements for PhD training.

Core Educational Elements: PhD

FASEB agrees that there are fundamental educational components of responsible, successful graduate education. Like many other professional organizations, including its member societies, FASEB has worked to identify core competencies reflecting the skills and knowledge PhD students should develop throughout their training:

- Discipline-specific knowledge – having detailed knowledge in a specific research area above and beyond a requisite broad knowledge of biological principles and processes
- Professionalism – developing professional attitudes and behaviors related to the conduct of research
- Communication skills – being able to communicate via written, oral, and visual media to audiences at all levels of scientific comprehension
- Research and analytical skills – acquiring the wide variety of skills needed to devise rigorous experimental designs, to analyze data, and to propose and test rational questions
- Management and collaborative skills – developing the abilities to manage personnel, projects, and grants; to network successfully to achieve optimal collaborations; and to work in teams and assume leadership positions
- Lifelong learning and career development skills – understanding the importance of staying current in one’s field of research as well as knowing steps needed in order to advance and/or change one’s career.

These are, in essence, the same elements identified by the Committee and, indeed by other professional groups and academic training programs. With strong agreement on the principles that should form the
foundation of PhD-level training, perhaps the focus should switch to what competency-based education looks like, how these competencies can best be incorporated into graduate programs, and how they can be effectively assessed. These are areas FASEB will be exploring through internal conversations and partnerships with others in the training community over the next year.

**Additional Questions for the Community**

Regarding “other offerings” that could enhance graduate education, two issues are of note. First, offering instruction in teaching and increased opportunities to gain teaching experience has the ability to significantly impact trainees’ development and future success. Although there are aspects of teaching in some of the elements listed in the Discussion Document, explicitly providing teaching instruction and experience would benefit students in many ways. For those intending to pursue academic or teaching careers, introduction to teaching methods and philosophy will make them more effective instructors, and therefore more competitive for such positions. For all students, though, the act of preparing and presenting lectures/lessons to ensure audience comprehension and retention will make them better communicators, and help them to more fully understand the content themselves. FASEB also suggests that “new” skills such as data management, team work, and leadership be included in modern graduate programs. Data management skills include knowing how and where to store and backup data to ensure current and future accessibility, an issue of increasing necessity with the proliferation of databases and new requirements by many journals and funding agencies that data be publicly accessible. Opportunities for participation in teams and multi-disciplinary collaborations, and guidance in management skills—including time and personnel management, conflict resolution, and delegation of responsibilities—will serve trainees well regardless of their career goals.

Second, although there is a growing body of career and career development information available through individual institutions’ graduate student and/or postdoc associations and career development offices, as well as from professional societies, there is still a need for a national center that would promote the dissemination and use of these resources through advocacy, training, and development of a resource repository. The American Society for Biochemistry and Molecular Biology is currently working with stakeholders to develop a National Center for Advancing the Career Development of Scientists. The center will:

- Develop and sustain a culture in Ph.D. and postdoctoral training that values all Ph.D. career outcomes and promotes proactive preparation for diverse careers
- Support local efforts to establish or enhance Ph.D. career development programs for Ph.D. life science trainees by universities, professional societies, employers, and other organizations
- Develop communities and networks across stakeholders to draw on diverse areas of expertise for advancing Ph.D. career development
- Drive innovation and research to advance the field of Ph.D. career development, thereby strengthening our scientific enterprise and the influence of science in our society by better preparing skilled, energetic scientists for the many different professions that need them.
Once this center is established, ambassadors will serve as a conduit to disseminate information about the resources available to institutions, faculty and trainees. Indeed, similar efforts to disseminate awareness and use of tools like individual development plans, and their responsible use by both trainees and advisors, can have a significant impact on graduate PhD education. This is particularly important now, as data show that the number of individuals obtaining biological/biomedical PhD degrees is holding steady or slightly increasing depending on the year, whereas the number of postdoctoral fellows in academia has declined year-to-year from 2010-2015\textsuperscript{1,2}.

FASEB acknowledges and accepts that a majority of PhD-level trainees will not pursue careers as academic researchers. However, it is incumbent upon us to remember that the foundational mission of biological and biomedical graduate education is in-depth training in research. Although graduate programs can and should make students aware of job market trends and realities, as well as career outcomes for previous trainees, the prospect of tailoring graduate education for employers’ needs is potentially problematic. In its \textit{Graduate Education Consensus Conference Report}, FASEB said “Projections of workforce needs are inexact, and changes in many areas affect employment trends...Key variables in the equation of supply and demand—faculty retirement rates, college enrollments, migration patterns, creation of new jobs in emerging areas—are notoriously difficult to forecast.” The Consensus Conference was held in 1996; those variables are just as hard to predict today as they were 20 years ago. Also from the \textit{Report}: “Each person is different, and the kind of job that is best suited for one person may differ from the job best suited for another. Faculty mentors should encourage students to consider a wide range of employment goals. Challenging job opportunities exist in academia, industry, and other non-academic settings.” However, in so doing, graduate programs should not lose sight of the core mission, which is to train the next generation of outstanding researchers who will tackle the difficult issues facing the nation and the world.

FASEB commends the Committee for taking on the important and difficult task of identifying areas of improvement in graduate STEM education, and looks forward to seeing your recommendations. If the Federation can be of further help, or provide additional information, please let me know.

Sincerely,

Thomas O. Baldwin, PhD
FASEB President