A PERSONAL VIEW | P-MIG Special Collection

The case for coordinating efforts to establish program guidelines and strengthen physiology undergraduate degree programs

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INTRODUCTION

Undergraduate degree programs named “Physiology” have existed for over 50 yr. The number of programs and enrolled students have been growing since ~2005 (5, 9). There are many thousands of students currently enrolled in physiology programs across the United States and indeed across the world. Despite the long history and current popularity of the physiology major, there is no coordinated plan articulated for the design, administration, or assessment of degree programs in physiology at the undergraduate level.

Although several professional societies have invested in undergraduate physiology education in various ways, none has undertaken the task of developing programmatic guidelines at the level of a degree program. This paper outlines the work being done by multiple stakeholders in physiology undergraduate education in the hopes of building a collaboration among interested parties. A large-scale collaboration could result in establishing consensus national programmatic guidelines. Through coordinated efforts, we ensure that entities with common educational interests are working together, and we collectively strengthen our programs to help our students succeed.

The goals of this paper are to: 1) draw attention to the lack of national, program-level guidelines for physiology undergraduate degree programs; 2) share ongoing efforts by stakeholders in physiology undergraduate education; 3) suggest a mechanism for coordination among stakeholders; and 4) discuss challenges and considerations for development of programmatic guidelines for physiology programs.

Why Care About the Lack of National Program-Level Guidelines for Physiology Degree Programs?

Curriculum guidelines are used at the K–12 and higher education, many STEM (Science, Technology, Engineering, and Mathematics) fields have established community consensus on undergraduate program-level guidelines in their respective disciplines, ranging from minimal guidelines to full program accreditation (Table 1). Most guidelines focus specifically on a sequence of courses, as this is the bedrock of any degree program. Recommended course sequencing is particularly beneficial for design and establishment of new programs. Some fields go beyond curricular content guidelines to establish broader programmatic guidelines that include student learning outcomes to be achieved over a full degree program. Programmatic guidelines may include professional skills development, experiential learning, internships, advising, and career planning, in addition to field content mastery.

Establishing program guidelines for undergraduate physiology majors would: 1) define fundamental physiology knowledge and skills; 2) communicate to internal and external audiences the strengths of an undergraduate physiology education; 3) provide cohesive guidelines for undergraduate physiology programs and departments; 4) establish guidelines for new and developing programs; 5) ensure better preparation for students entering medical, professional and graduate programs; and 6) promote and articulate career readiness for success in research, science education, health care, and other fields in which a scientific or analytic background is advantageous. In the absence of guidelines, each program individually sets the course offerings, course sequencing, and overall focus on the major based on local expertise, leading to lack of fidelity across programs. However, this is a problem because many degrees have a physiology emphasis, but the degree is not called “physiology.”

What Are the Recent Actions of Societies in Support of Undergraduate Physiology Education?

Association of Chairs of Departments of Physiology. Association of Chairs of Departments of Physiology (ACDP) departments are primary focused on graduate and medical education, but an estimated 5% also include undergraduate programs. A key concern among the ACDP Chairs is that stand-alone medical school physiology courses are being lost in favor
of integrated curricula that merge physiology into case-based learning and disease-focused modules. Therefore, physiology education at the undergraduate level becomes increasingly important. ACDP has an interest in helping to set program guidelines for physiology undergraduate programs to ensure that students entering medical school, other professional schools, and graduate programs have the appropriate background for success.

With the intention of better understanding the training happening within undergraduate physiology programs that educate the students enrolling in their graduate and medical schools, ACDP hosted sessions at their annual leadership retreat on physiology undergraduate programs in 2015, 2016, and 2018. Discussions were related to the current state of undergraduate physiology programs, professional skills development at the undergraduate level, and inclusion of the Core Concepts of Physiology (21) at the course and program level. In 2016, ACDP established a committee to evaluate core concepts of physiology, or recurring themes that apply to numerous physiological processes, recommended for inclusion in undergraduate physiology course work.

Human Anatomy and Physiology Society. The Human Anatomy and Physiology Society (HAPS) has been a major contributor to anatomy and physiology (A&P) education. HAPS hosts annual meetings to support A&P educators at all levels. It provides strong support in particular for 4-yr institutions and community colleges, hosts a community-driven discussion forum, provides a vibrant community for educators, maintains learning outcomes for one- and two-semester A&P courses, and curates standardized exams for A&P courses. HAPS recently released learning outcomes for stand-alone anatomy courses and is currently writing learning objectives for stand-alone physiology courses at the undergraduate level. The HAPS A&P learning outcomes have been adapted by several major A&P textbook publishers in the United States (8). This is a solid foundation upon which to build, bringing the discipline a step closer to the establishment of a common set of learning outcomes that can be applied at the program level.

American Physiological Society. Within the American Physiological Society (APS), engaged individuals have spoken on behalf of undergraduate education for many decades, and there have been multiple committees formed to address key issues. APS sponsors both the Teaching Section and the Physiology Educators Committee (formerly Education Committee). Since 2014, APS has hosted a biennial education-focused conference for faculty who teach physiology at the college and medical school level (Institute on Teaching and Learning). APS formerly kept a database of physiology undergraduate and graduate programs in the US.

A subcommittee of the APS Education Committee completed extensive work in 2014–2015 in consideration of a certification process for undergraduate physiology programs, even drafting an unpublished white paper on undergraduate degree programs and best practices for engagement with undergraduate students. Key recommendations included the following: 1) host a recurring networking session for physiology degree programs at Experimental Biology and investigate how other societies support their related undergraduate programs; 2) investigate how other societies support their related undergraduate programs; 3) generate a survey instrument to learn more about undergraduate programs; 4) publish white papers on the issues facing undergraduate education; 5) create a collection of relevant documents for undergraduate programs in physiology; and 6) consider a grant to host a conference for undergraduate programs in physiology. While this initiative for exploration and support of undergraduate programs within APS did not materialize, direct support of undergraduate students has been accomplished through a research-focused directive to host robust summer research fellowships (the APS Undergraduate Summer Research Fellowship program) and conference travel awards to support the pipeline of undergraduate students interested in careers in research. Recently, undergraduate physiology education has been featured in several APS publications, indicating the renewed and dedicated interest of APS (18, 24–26).

National Association of Advisors of Health Professional. The National Association of Advisors of Health Professional (NAAHP) is the society for higher education advisors for pre-health-care career undergraduate students. Therefore, it is a very important group for the physiology program to coordinate with, since ~90% of students enrolled in our programs are aspirational pre-health track (21a). This group is well informed about admission requirements and updates for a wide range of programs, including medicine, physical therapy, and physician assistant. While to date there has not been a formal partnership between NAAHP and physiology societies, this would be a natural progression.

A Possible Mechanism for Coordinating Efforts: The Physiology Majors Interest Group

Briefly, the collegiate programs that joined the independent, grassroots collective called Physiology Majors Interest Group (P-MIG) shared a focus on human and integrative physiology with a population of students that are largely pre-health care track. P-MIG has been working across society boundaries since 2015 with a focus on issues at the level of the undergraduate degree program (23). P-MIG’s diverse membership can serve to coordinate the efforts noted above to strengthen undergraduate degree programs. See the companion paper for more information about the history of P-MIG (23). We envision co-hosting a “summit” where a representative from each of the various stakeholder groups and other
experts in discipline-based education research and curricular guidelines would join to share ideas.

P-MIG currently has three committees devoted to the development of program guidelines: curriculum and core concepts, professional skills, and advising. These committees represent the vision of P-MIG not only to provide guidance on the course work and content in physiology, but also to focus on excellent advising, career development, and professional skills training to ensure career success, regardless of a student’s path. However, hiring trends show that many students will track into different career paths, despite their pre-health professional goals, which are explored more in other papers in this collection. These committees are making progress on this work, as well as pilot assessment, rubrics, and other tools, to assess the programs and monitor student learning outcomes in the major (9, 20).

To serve the community, P-MIG has launched a website and listerv (14). We aim to keep a repository of program resources and a list of physiology programs up to date. Teaching and learning resources featured include tools for programmatic assessment, learning progressions in physiology and other standardized assessments such as Phys-MAPS (19), professional skills development (2, 3), concept inventories on homeostasis (12), core concepts of physiology, course level learning objectives, and other course-specific resources. This serves as a supplement to the plethora of resources for individual physiology courses provided by publishers, individual faculty, in the literature on the scholarship of teaching and learning, and in LifeSciTRC (11).

P-MIG is the current incarnation of dedicated individuals who naturally joined forces to solve a collective problem and share ideas about undergraduate education. The founding mission was broad and simple: to address common issues facing undergraduate degree programs in physiology, such as identifying best practices regarding course requirements and program outcome measures. The timing of P-MIG launching coincided with a period of growth of enrollment in programs and addition of new programs. There was a time when perhaps it was perceived that the physiology major was dying, but, given its resurgence, it is timely that a national discussion takes places on what it means to be a physiology major. Certainly, this is not the first, nor will it be the last, group to tackle challenges in physiology education. In fact, it is not the first time a group convened to talk about program level issues. The group “stands on the shoulders of giants.” It is only due to innumerable individual efforts and work within stakeholder societies that any of the current work in P-MIG could be happening.

If There Are So Many Invested Groups, Why Haven’t Programmatic Guidelines for Physiology Degree Programs Already Been Set?

The issues that need to be addressed for developing program guidelines are largely in three areas, as revealed in P-MIG discussions with members: pre-health-care-focused students, defining what a physiology major is, and determination of natural boundaries for inclusivity for programs that would be served by guidelines.

A key issue that has likely contributed to the lack of guidelines is that the primary career aspirations of students within physiology majors is a range of pre-health-care tracks, including medicine, physician’s assistant, and physical therapy (7, 21a). Therefore, the student body is not strictly the purview of any single professional discipline or society. To complicate matters, students may also pursue a range of other careers in research, policy, administration, and other fields. Career aspirations and career trends are discussed in depth in the cited companion papers (15, 21a). Which society could oversee the whole of pre-health care student learning? What society is most likely to oversee the curriculum for pre-health majors? What scientific society is interested in the training of future health care providers in all sectors? How would a society oversee top notch training for health care careers, while also supporting the pipeline for basic science research and other biomedical careers?

Another challenge in setting national programmatic guidelines is the diversity in what is considered a “degree program in physiology.” In The College Blue Book, only programs with the one-word title of “physiology” are listed (15, 22, 23). We find this definition too limiting. What if “physiology” is part of the program name (e.g., Human Physiology, Applied Physiology, Integrative Physiology, Exercise Physiology, Comparative Physiology, Mammalian Physiology, Plant Physiology, Cell Physiology)? What if “physiology” is a formal concentration or track within a broader major (e.g., biology with a focus in physiology, health science with a concentration in physiology)? The National Center for Education Statistics Center degree coding system [Classification of Instructional Codes (CIP)] allows for programs to choose their designation based on the degree titles listed in Table 2 (13). Would physiology program guidelines be targeted at those who are

| Table 2. National education statistics center classification of instructional codes |
|-------------------|-------------------|-------------------|-------------------|
| Physiology, Pathology and Related Sciences |
| Physiology, General |
| Molecular Physiology |
| Cell Physiology |
| Endocrinology |
| Reproductive Biology |
| Cardiovascular Science |
| Exercise Physiology and Kinesiology |
| Visions Science/Physiological Optics |
| Pathology/Experimental Pathology |
| Oncology and Cancer Biology |
| Biomechanics |
| Physiology, Pathology, and Related Science, Other |
| Health/Medical Preparatory |
| Pre-Dentistry Studies |
| Pre-Medicine/Pre-Medical Studies |
| Pre-Pharmacy Studies |
| Pre-Veterinary Studies |
| Pre-Nursing Studies |
| Pre-Chiropractic Studies |
| Pre-Occupational Therapy |
| Pre-Oncology |
| Pre-Physical Therapy |
| Health/Medical Preparatory Programs, Others |
| Biology, General |
| Biology/Biomedical Sciences, General |
| Biomedical Sciences, General |
| Biological and Biomedical Science, Other |
| Biological and Biomedical Science, Other |
| Zoology/Animal Biology |
| Animal Physiology |
listed under the broad heading “Physiology, Pathology and Related Sciences” or should it be limited to “Physiology, General”? Are forthcoming program guidelines based on the name of the degree, the CIP code, the student career aspirations in the major, the common courses in the curriculum, or something else?

Degree programs are commonly named by the discipline or department that contributes most of the courses to the program. Physiology defies this convention because of its dependence on multiple natural sciences (e.g., biology, chemistry, physics, biochemistry) and inherently interdisciplinary qualities. Depending on the size and type of institution, it may not be possible or realistic to have an entire department devoted to physiology. Thus, when thinking of programs that are “physiology programs,” we must be fairly inclusive in particular with respect to small schools that do not have a Physiology Department.

Since the founding members of P-MIG were all from programs titled physiology that served aspirational pre-health students (23), the emphasis of P-MIG thus far has been on human and/or integrative physiology. Programs with common student career goals and an emphasis on human/integrative physiology have joined P-MIG, seeing themselves as similar. Those that do not formally include physiology in the title (e.g., exercise science, health science, or integrative biology) may consider themselves “physiology” programs if they contain multiple physiology courses and have similar programmatic goals, or if they have selected a CIP code in that category. P-MIG members’ programs, regardless of degree title, are active in the group, participate in committees, and seek for the guidelines to be inclusive to their programs.

Given the above complexities, it would be hard to argue that all degree programs that have physiology in a title, or see themselves as physiology focused, could all have the same needs. This makes the probability unlikely that one set of highly prescriptive standards or an accreditation model for all programs would be appropriate. It would be more likely that a more general set of overarching program guidelines would be more suitable.

Despite the challenges of defining a physiology major from a wide range of program names and types, program guidelines have been developed to address a range of named programs that serve students interested in diverse careers, accomplished by other organizations. The American Kinesiology Association (AKA) has published program guidelines and departmental rubrics for their undergraduate programs (6). Much can be learned from the AKA guideline model because: 1) it serves as an excellent model for a national society to take the lead on setting and maintaining program guidelines at the undergraduate level; 2) it is a model for future physiology program guidelines because there is some crossover of student interest whom these programs serve (e.g., physical therapy); and 3) AKA has generated rubrics and guidance for program evaluation using the guidelines. In fact, some have even argued that perhaps the work of AKA can include physiology programs. However, there are distinctions, such as the focus on exercise physiology and the predominance of pre-physical therapy track students over pre-medical students that make the AKA guidelines not applicable to many of the programs in P-MIG. Therefore, while the work of AKA may be exemplar, it is insufficient for many programs (1, 9, 20).

Current Status and Next Steps

This paper is part of a special collection of papers in which P-MIG members report in detail on the efforts to date for writing curriculum guidelines that include the core concepts of physiology (4, 21), best practices for advising the physiology student (4), considerations for incorporation of professional skills development in degree programs (5), the launch of a novel curriculum mapping tool to allow alignment of course objectives to program guidelines (20), applications and utility for program guidelines (9), and a comprehensive. Please refer to our future directions paper (1), which serves as a summary of the collection and articulates a plan for how the community can move forward together. As noted above, a “summit” of stakeholders would be a productive next step. In addition, we are seeking partnerships with experts in curricula reform, survey methods, and physiology education research to join this work to meet the needs identified by the P-MIG membership.

Summary

There are numerous stakeholders that support undergraduate physiology education in meaningful ways, namely APS, HAPS, ACDP, NAAHP, and many key individual educators. P-MIG is immensely grateful to those who came before us and laid the foundation for our work as we seek to partner in establishing national guidelines for programs. P-MIG is taking the lead to better understand what a physiology major is and help articulate a unified vision of excellence in physiology degree programs worldwide. This work will benefit the student learning experience in our programs, faculty designing courses in the majors, overall cohesion among related programs, and will enhance career success for our graduates.

This paper is published as part of a special collection/special issue from P-MIG, a grassroots organization that has formed to help develop programmatic guidelines and serve those engaged in undergraduate physiology or physiology-related programs. To find out more about this collective, or get involved, please visit our website (https://www.physiologymajors.org) and consider joining our listerv.

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DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

AUTHOR CONTRIBUTIONS

E.W. and J.R.H. conceived and designed research; L.C.A., A.R.C., and J.R.H. interpreted results of experiments; E.W., L.C.A., A.R.C., C.I.S., J.M.P., J.R.H., and J.R. edited and revised manuscript; E.W., L.C.A., A.R.C., C.I.S., J.M.P., J.R.H., and J.R. approved final version of manuscript.

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