A PERSONAL VIEW | P-MIG Special Collection

Start with the end in mind: using student career aspirations and employment data to inform curriculum design for physiology undergraduate degree programs

Keeler J. Steele,1 Valerie S. VanRyn,2 Claudia I. Stanescu,3 Jennifer Rogers,4 and Erica A. Wehrwein1

1Department of Physiology, Michigan State University, East Lansing, Michigan; 2AD Instruments North America, Colorado Springs, Colorado; 3Department of Physiology, University of Arizona, Tucson, Arizona; and 4Department of Health and Human Physiology, University of Iowa, Iowa City, Iowa

Submitted 2 September 2020; accepted in final form 8 September 2020

Overview

As the costs of higher education rise and student loans cripple college graduates entering the job market, it is more important than ever for undergraduate students to receive appropriate training to maximize their marketability. None of us wish to see students ending up in a “dead-end” situation, where they are underemployed for their training, face multiple gap years, find themselves in situations where it is difficult to progress in their fields, or are stalled in pursuit of further education to achieve their goals. Ideally, with the support of well-designed degree programs that offer formalized career exploration and professional skills development in the major, graduates of physiology programs will find meaningful employment in the field or matriculate into advanced education programs at the graduate level.

Undergraduate educators could play a direct role by seriously considering how their coursework, advising, and degree program curricula contribute to the long-term career success of their students. Faculty and advisors in undergraduate programs would need to be aware of their students’ career goals and the current job market trends to maximize student employment success after college. By being informed and intentional about careers, educators can help ensure that employers and graduate programs will find top candidates with optimized background and experiences when they select graduates from physiology degree programs.

Physiology Student Aspirations and Career Paths

Physiology undergraduate degree programs overwhelmingly serve pre-healthcare track students (12). Unpublished internal data from Michigan State University and the University of Arizona consistently show similar trends, with ~90% of physiology students aspiring to a career in the healthcare field with 60% interested in medicine. Student survey data from physiology programs in the U.S. shows that the top three career options are medicine, physician assistant, and physical therapy (17). Students may lack awareness of other lesser known healthcare careers or of other life science career options, such as graduate school in physiology, biology education, industry, and the like.

What is it about a physiology degree that attracts pre-health students? A degree in physiology commonly provides undergraduate students a solid science background to prepare for admission tests. It also creates a scaffolding for medical physiology coursework and a strong framework to help those who matriculate succeed in the pre-clerkship phase of medical school. Students see the applicability of physiology as the basis of medicine and use that ideal as a driver of their decision to study physiology and life sciences as an undergraduate, as opposed to studying a physical science or a non-science degree.

Job Market: Healthcare

Data published by the U.S. Board of Labor and Statistics provide a promising outlook for the career aspirations of physiology students. Most physiology students are on a track toward a career in healthcare, where many positions are expecting well above average job growth in the next ten years (21). For example, occupational therapy is expecting 33.1% job growth in the next decade, an increase of 14,500 positions. The need for physician’s assistants is projected to increase 31.1% over the next decade, adding 37,000 positions. Similarly, there will be a 7% increase of physicians and surgeons, adding 55,400 positions (21). These numbers are very favorable for the pre-health track physiology students to fill the voids, and they reflect the demand of a growing healthcare workforce.

According to a Hamilton Project study of post-college career paths sponsored by the Brookings Institute in 2017, 16.9% of physiology majors become physicians and surgeons, earning an average of $166,000 annually (18). This is the most common job for physiology majors, as the other most common jobs are comparatively fractional. Consequently, 4.6% become physical therapists, 4% become registered nurses, 3.9% become postsecondary educators, and 3.6% become chiropractors. Interestingly, only 2.8% of physiology majors become dentists, 1.8% become physician assistants, and 1.7% become medical and life scientists. The Hamilton Project reports that 40.8% of physiology graduates find employment in “different jobs” that are described as primarily unrelated to their field of study. Fortunately, the overall total employment of these students is high; 69.1% of physiology graduates are employed full time, 14.5% are employed part-time, while only 2.3% are unemployed and searching for work. The remainder are either in an academic program, not working, or not seeking work (20).

For comparison, according to the Hamilton Project data, 23.9% of biochemistry majors and 22.6% of molecular biology majors become physicians and surgeons and account for the greatest annual earnings for both groups. The occupation frequency trends for these majors are like that of physiology, with other occupations being relatively fractional compared
with physicians and surgeons. These occupations include other managers, other physical scientists, medical and life scientists, postsecondary educators, and clinical laboratory technologists/technicians. For both groups, the “other managers” category represents the second-highest annual earnings.

There are currently many more applicants than there are training slots available in medical schools, with the AAMC reporting 53,371 applicants for 21,269 training slots in 2019, which represents a relative success rate of ~40% (2). The good news is that life sciences majors are the most competitive applicants (2). Similar competition is found in applicants for physician assistant school, where 27,283 students applied for 8,802 training slots in 2018, a success rate of ~32% (15). This also leaves many students seeking alternative, but related, careers.

**Job Market: Other**

The types of careers available to graduates of a Bachelor of Arts or Bachelor of Science in physiology program who do not pursue graduate education are generally more role specific in that they encompass numerous support staff and project management positions. According to the *What’s It Worth? The Economic Value of College Majors* report (4), physiology majors are most likely to have a career in a health profession, where a bachelor’s degree is a minimal education requirement. They may also have positions in management, sales, office occupations, and community/nonprofit organizations in respective descending proportions. Some of these positions are not rooted in life science but require professional development consistent with a life science major. Classified by industry, they are most likely to work in health services, followed by education services, retail trade, financial services, and public administration. This diversity in post-degree career options makes the point that undergraduate degree programs in physiology and pre-health preparation need to ingrain broad employability and professional skills in the major to prepare students for a range of careers (5–7).

Data published by the MSU Collegiate Employment Research Institute for the 2019–2020 annual report indicates a favorable hiring economy for new college graduates (10). The report cites employer optimism in economic outlooks as the primary driver of hiring new college graduates. Of the respondents, 92% describe the new college labor market in their industrial or economic sector as good to excellent, particularly for larger organizations. Healthcare services are expecting a 16% new graduate hiring increase for the current year (10). Taken together, there is a positive career outlook for college graduates with expected increases in positions in the healthcare sector. However, it must be noted the report was released before the COVID-19 pandemic. The Collegiate Employment Research Institute has already issued an advisory of the substantial impact that will be evaluated in the 2020–2021 report.

**Earnings Potential**

Career options for students intending to enter the workforce with a bachelor’s degree, as well as those not accepted to a professional school, need to be addressed. In 2011, physiology majors represented 4% of biology and life science students, 45% of whom ended their career with a terminal bachelor’s degree. Their median annual income was $45,000, but one could expect 78% earnings increase by obtaining a graduate degree (4). In 2013, 42% of biology majors (which absorbed the physiology subgroup) ended their education with a bachelor’s degree with a median annual income of $56,000, despite 64% earnings increase by obtaining a graduate degree (3). In health preparatory degrees, programs are designed for maximum return on investment. In 2013, only 23% of these student’s ended with a bachelor’s degree, with a median annual income of $54,000, but 137% earnings increase by obtaining a graduate degree (3). Additional data from these reports are summarized in Table 1.

**Importance of Surveys of Students and Graduates**

While the national aggregate data summarized above is very helpful, it is important that each department learn as much as possible about career aspirations and outcomes in their graduates. Regular surveys of current students, inclusion of student representatives on program curriculum committees, and partnership with student clubs in the major are all good tools that can inform program faculty about new trends in student career interests. Tracking graduates after commencement and asking them how the program could have been more helpful would be useful in revising and improving the programs. Although it is challenging to track students after they leave campus, it is an important effort. A combined investment from the department and college could help with this process.

While there are challenges with tracking outcomes, it is worth considering options for how this can be done. Some ideas are as follows: 1) working with data from the alumni association; 2) connecting with alumni through departmental newsletters and social media; 3) creating departmental “advisory boards” comprised of alumni (which also would be suitable for meeting with student groups, providing internship opportunities, job shadowing, etc.); and 4) using current students as a source to assist with these tracking needs through department-sponsored volunteer leadership positions. Student efforts to assess trends would enhance their own awareness of career paths and facilitate networking. Interactions between past and current students could create opportunities for job shadowing, internship connections, and alumni investment in the department. Students would also develop interpersonal skills when reaching out to alumni and student groups for data collection (1).

**Designing a Physiology Curriculum Using Career Data**

Designing physiology degree programs to include explicit focus on career and professional development rather than a narrow scope of science course content would support long-term success for students. In turn, it would positively reflect on the preparatory commitment of a program. To design a curriculum with the end in mind, faculty would need to answer questions such as the following. What is the best curriculum for a pre-health student in my physiology program who is very unlikely to desire a long-term career in research? Would it be advisable to design the physiology undergraduate program in consultation with clinical faculty, healthcare providers, and other stakeholders? Would basing curricular planning on guiding documents like the foundations for future clinicians (13) be more engaging and meaningful to our students? How does my course or this major align with the expectations of admissions boards or employers? What do alumni who did not follow a path into research have to say about our program? The answers to these questions would provide valuable feedback into areas for
improvement and would allow physiology programs to use this information for future recruitment of students into their programs and longevity of student success.

Some schools have career services experts on campus, college-led alumni tracking, and well-informed advisors. However, a communication gap often exists between the nonfaculty career services experts and the faculty responsible for developing a curriculum. Information provided by these resources is rarely used when deciding which assessments and learning objectives to include in a course, nor is it used when determining which courses belong in the major. Few advisors and faculty have time to read jobs reports or have access to the outcomes data from their institutions. Instead, the course offerings in any given undergraduate program are often a mix of collegiate requirements, local faculty expertise, and decisions made by faculty based on their own perceptions of what is most important for students to know.

A possible solution to this common problem faced by physiology programs would be to create a student-led group or a student leadership position within the major to collect information on alumni career paths and communicate it to the curriculum committee. If a student representative were included in the curriculum committee, this could be their yearly task to keep the committee informed of current trends. In turn, the students would gain experience with stakeholder analysis and organizational development.

When science faculty with a PhD are assigned to teach prehealth students, it is possible that course design is naturally focused through the lens of the faculty’s expertise and research interests. Through research-focused courses, such as senior seminars and journal clubs, students practice critical thinking, analysis of data, reading of scientific literature, and understanding experimental design, skills that are applicable to several career pathways, including medicine. However, remembering that the career aspirations of our students do not align with a research or academic career, it is worth an evaluation of program course offerings to ensure that curricular content offers a clinical perspective. Inclusion of clinical cases in teaching, laboratory course experiences that offer exercises in common clinical measurement, and pathology courses would serve student interests. Given the overwhelming predominance of student interests in human and integrative physiology (19), this would better prepare students for a future career in the healthcare sector. Incorporating learning activities such as case studies would help develop value in program curricula and students’ perceived return on investment.

Use of real-life clinical cases and healthcare scenarios in the curriculum leads to student engagement by allowing students to picture themselves as healthcare professionals when solving these problems. Fortunately, these types of activities also allow students to practice key professional skills, such as critical thinking.

The Need for Broad Employability Skills Training

Generalizable professional skills are essential. It is fortunate that the skills sought by employers and professional schools are homogenous. As such, educators in physiology programs can prepare students for admission to graduate programs or for employment after graduation by training the same skill sets: teamwork, communication, critical thinking, integrity/ethics, cultural competence/diversity, adaptability/embracing change, and reliability/dependability are universal. These competencies are listed on applications for professional schools, are necessary to talk about in letters of recommendation for successful applicants, and are core areas of focus for employees looking to progress up their career ladder. They are specifically identified as benchmarks for qualified applicants to healthcare leadership positions, both medical and executive. It is essential that we inform undergraduate students about the expectation that they will have mastered key professional skills, provide formal opportunities for them to practice, and offer constructive feedback on their progress in development of these skills.

One model for inclusion of such professional skills in a training program is called the “T-shaped” professional (11). The broadly trained T-shaped professional is sought after by employers and is a guide to building professional competencies (9). The basic premise is that there are boundary crossing competencies, such as teamwork, communication, critical thinking, and project management, that one would expect of a student with a liberal arts background, in addition to deep discipline and systems knowledge. A student trained with this approach during an undergraduate program would be considered to have specific ability for and deep understanding of analytic-thinking and problem-solving methods within the disciplinary content of his/her field. This person would be an ideal employee with a contextualized content knowledge that can be readily applied to a broader system such as healthcare while also having strong professional competencies.

There are unique opportunities for a physiology student to expand his/her professional skill capabilities to become a T-shaped professional by working in teams, communicating across representational boundaries, and developing critical thinking for broad disciplines and systems in their courses. Inclusion of professional skills development in national programmatic guidelines is proposed in the companion paper by French et al. (9). If this professional development approach to undergraduate training is leveraged, especially with respect to knowledge of clinical correlates or healthcare organizational operations, the physiology student stands a better chance of competing for leadership and administration positions after graduation. Finally, a strong set of general professional skills will allow students to be flexible in the job market and maximize marketability in many careers.

Career Exploration in the Major

The data previously described indicate most students are interested in careers in the familiar healthcare posts: physician, physician assistant, and physical therapy. There is a
plethora of healthcare-focused careers of which students are often unaware that could be an ideal route to a rewarding career. The issue is awareness and access to people in those fields that open the necessary connections and experiences. It would be a great asset to students if they were guided to alternative careers, such as anesthesia assistant, cardiac perfusionist, intraoperative neurophysiological monitoring technician, respiratory therapist, occupational therapy, speech pathology, music and recreational therapy, genetic counseling, or public health (8, 22).

There are several ways to incorporate career exploration into the major. 1) Design a required career course in the degree program that is run by the department. Perhaps a 100-level required course on career options and hiring projections, where students learn about the wide range of healthcare careers aside from medicine would be useful. 2) Partner with career services or other campus offices to offer a career course. Student requirements to meet with career services and complete career interest surveys could help prompt meaningful career exploration as part of the major. A good example is the individual development plan for science careers (14). There are also web-based resources on healthcare careers (8) and other careers for physiology majors (15) that could be provided during a course or advising appointment. 3) Use an integrative approach where career development and professional skills are taught within existing courses in the major (5, 7). 4) Generate a robust resource list available to students in the program. The Physiology Majors Interest Group (PMIG) website career tab is an evolving and growing database of the wide range of careers for our majors (19). There is a largely untapped connection directly between the job sector and undergraduate educators. It is likely that partnerships with related local businesses or health systems would be informative to curriculum planning, as well as provide role models for our students, internship opportunities, potential mentors for your students, and even guest speakers in our courses. The ability to acquire internships or experiential learning credits through career shadowing and writing reflective essays is an appealing option.

Summary

We feel strongly that career data should be a consideration in course and curriculum design. It is part of our job to ensure that we design meaningful learning experiences with an eye on guiding future professionals into their career of choice. In the case of physiology majors, a large proportion of students aspire to work in a healthcare career, but ~45% of physiology students will, for a variety of reasons, end their education with a terminal bachelor’s degree. Thus programs should be designed to serve both audiences well.

As programs consider a focus on career trajectory, here are some suggestions for ways to address this in the major. 1) Include clinically relevant coursework and human physiology laboratory coursework, regardless of future career plans. 2) Create a required course in the major that is focused on career exploration and professional development, which would be desirable and well regarded by students, providing opportunities to explore careers early in the undergraduate program. 3) Require opportunities to explore various lesser known healthcare careers, opportunities for clinically relevant internships, and mentoring programs with alumni in a variety of fields. 4) Focus in the major on career development and professional skills is the key to successful employment in any sector. The professional skills for physiology students laid out in the companion paper by French et al. (9) are essential for well-rounded training for undergraduate physiology students worldwide. 5) Improve training for advisors to better understanding student career aspirations is important for individualized advising (7).

In conclusion, we advocate for a “backwards design” approach, considering the career outcomes as a critical part of our curriculum design. The incorporation of career exploration and professional skills training relevant to the discipline as a required part of the undergraduate program will ensure our students are highly competitive applicants for graduate/professional school or entry-level positions in the job market.

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 for undergraduate degrees in the discipline and to 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 list serv.

DISCLOSURES

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

AUTHOR CONTRIBUTIONS

E.A.W. conceived and designed research; K.J.S. and E.A.W. drafted manuscript; K.J.S., V.V., C.I.S., J.R., and E.A.W. edited and revised manuscript; K.J.S., V.V., C.I.S., J.R., and E.A.W. approved final version of manuscript.

REFERENCES

1. Ashline G. Real-world examples: developing a departmental alumni network. PRIMUS (Terre Haute Ind) 27: 598–605, 2017. doi:10.1080/10511970.2016.1234528.

2. Association of American Medical Colleges. Table A-1: U.S. Medical School Applications and Matriculants by School, State of Legal Residence, and Sex, 2019–2020 (Online). https://www.aamc.org/system/files/2019-11/2019_FACTS_Table_A-1.pdf [1 Aug 2020].

3. Carnevale AP, Cheah BH, Hanson AR. The Economic Value of College Majors. Washington, DC: Georgetown University Center on Education and the Workforce, 2015.

4. Carnevale AP, Strohl J, Melton M. What’s It Worth: The Economic Value of College Majors. Washington, DC: Georgetown University Center on Education and the Workforce, 2011.

5. Choute J, Demaria M, Ethève M, Cran S, Carroll D. A professional development program with an assessed ePortfolio: A practical solution for engaging undergraduates with their career development in large student cohorts. J Teach Learn Grad Employ 10: 86–103, 2019. doi:10.21153/jtلجe2019vol10no2art788.

6. Choute J, Harrison L. Why do science students study physiology? career priorities of 21st century physiology undergraduates. HAPS Educ 27: 59–63, 2019. doi:10.21692/haps.2019.010.

7. Crecelius AR, Crosswhite PL. Advising physiology students: perceptions from the programs. Adv Physiol Educ. In press. doi:10.1152/advan.00184.2019.

8. EHC. ExploreHealthCareers.org (Online). https://explorehealthcareers.org/ [17 Dec 2019].

9. French MB, Choute JK, Zubek J, Bryner RW, Johnson KMS, Luttrell MJ. Professional skills for physiology majors: defining and refining. Adv Physiol Educ. In press. doi:10.1152/advan.00178.2019.

10. Gardner P. Recruiting Trends Report: 2019–2020 (49th Ed.). East Lansing, MI: Michigan State University, 2019.

11. Gardner P, Maietta H. Advancing Talent Development: Steps Toward a T-Model Infused Undergraduate Education. New York: Business Expert Press, 2020.

12. Henriksen EJ, Atwater AE, Delamere NA, Dantzer WH. The physiology undergraduate major in the University of Arizona College of Medicine:
past, present, and future. *Adv Physiol Educ* 35: 103–109, 2011. doi:10.1152/advan.00089.2010.

13. Lubetsky JB. *Scientific Foundations for Future Physicians*. Washington, DC: HHMI-AAMC, 2009.

14. MyIDP Science Careers. *myIDP Science Careers* (Online). https://myidp.sciencecareers.org/ [17 Dec 2019].

15. Physician Assistant Education Association. *The PA Pipeline to Practice Applicant and matriculant data from CASPA*. Washington, DC: Physician Assistant Education Association, 2019.

16. Physiology Majors Interest Group. *Physiology Majors Interest Group* (Online). https://www.physiologymajors.org [9 Dec 2019].

17. Rogers J, McFarland JL, Stanescu CI, Crosswhite PL, Crecelius AR. The 2019 P-MIG Student Survey and capturing the undergraduate perspective of physiology programming. *Adv Physiol Educ*. In press. doi:10.1152/advan.00189.2019.

18. Schanzenbach D, W. Nunn R, Nantz G. Putting your major to work: Career paths after college. *The Hamilton Project* May 11, 2017.

19. Steury MD, Poteracki JM, Kelly KL, Wehrwein EA. Perspectives of physiology as a discipline from senior-level millennial-generation students. *Adv Physiol Educ* 39: 240–241, 2015. doi:10.1152/advan.00104.2014.

20. The Hamilton Project. *Putting Your Major to Work: Career Paths after College* (Online). https://www.hamiltonproject.org/charts/median_earnings_for_largest_occupations [18 Dec 2019].

21. U.S. Bureau of Labor Statistics. *Occupational Outlook Handbook* (Online). https://www.bls.gov/ooh/ [16 Dec 2019].

22. U.S. News and World Report. *Best Healthcare Support Jobs* (Online). https://money.usnews.com/careers/best-jobs/rankings/best-health-care-support-jobs [1 August 2020].

23. Wehrwein EA, Poteracki JM, Halliwill JR. A brief history of the Physiology Majors Interest Group (P-MIG). *Adv Physiol Educ*. In press. doi:10.1152/advan.00176.2019.