The Biophysicist

National Academies Report and Biophysics Education

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The US National Academies (of Engineering, Medicine and Sciences) recently issued a decadal survey report on the field of biological physics titled *Physics of Life*, which can be read and downloaded at https://www.nationalacademies.org/our-work/biological-physicsphysics-of-living-systems-a-decadal-survey. The purpose of this editorial is to summarize a few prominent points discussed in the section on biophysics education and thereby stimulate readers of *The Biophysicist* to examine the report itself. In addition, we wish to solicit from the greater biophysics education community (including biology, chemistry, physics, bioengineering, materials engineering, and so on) a response as to how the findings of the report can impact and improve biophysics education at the international and interdisciplinary levels. These can be submitted to this journal. (This can be done via the submission site: https://thebiophysicist.msubmit.net/cgi-bin/main.plex. Choose article type: "Book Reviews and Comments." Comments are generally limited to 1 journal page.) Responses that relate to the education section of the report, that are novel, and that are of general interest to biophysics education may be selected for publication as comments.

The report was written as a consensus by a distinguished committee of scientists headed by its chair, Professor William Bialek of Princeton University. The committee also solicited ideas from other colleagues with complementary expertise as well as input from 2 town meetings: one held at the Biophysical Society meeting and the other held with the Division of Biological Physics of the American Physical Society. The report includes a summary of the big questions in the field (e.g., How do macroscopic functions of life emerge from interactions among many microscopic constituents?), the relationship of biological physics to other fields (e.g., physics, chemistry, biology, health, medicine, and technology), and how education, funding, collaboration, and inclusion are important in realizing the full promise of the field. The introduction section discusses the relation between biophysics (and computational biology), often seen to revolve around the development and use of physics "tools" to solve biological problems, in contrast to biological physics as a subfield of physics itself. This relationship is dynamic, and the distinction may fade in time; what is important are the research accomplishments that answer interesting and important scientific questions. It is not the point of this editorial nor the role of this journal to debate the current nomenclature of the field. *The Biophysicist*'s mandate as an academic journal is to provide a home for articles on how biophysics education

Received: 27 October 2022
Accepted: 27 October 2022
Published: 27 December 2022

can be conceptually studied (as a subfield of science education) and to apply this understanding to the development of new teaching and learning tools, methodologies, and assessments.

Interestingly, the report notes that the “majority of input” received from the larger community involved education. At the narrower, disciplinary level, there was some concern and discussion of how to ensure that biological physics takes its place in the physics educational curriculum, especially at the undergraduate level. The committee concluded that resources should be developed to communicate how biological physics examples can be used to teach fundamental principles of physics. In addition, they advocated that more emphasis should be placed in the first courses in statistical physics on topics such as nonlinear dynamics and the statistical mechanics of interacting systems, because both of these aspects are fundamental to a modern understanding of the physics of biological systems. On the interdisciplinary plane, the report emphasized that crossing disciplinary boundaries involves, to a large extent, the learning of new languages and is therefore most effective if done at an early stage of a student’s education. A related question is how to optimally teach biology to physics students (who often have no course requirements in biological or chemical sciences) and quantitative physics to chemistry and biology students beyond their required introductory courses in physics. These 2 groups of students may have different orientations: Physics students are generally motivated by an understanding of universal principles that minimizes the “facts” that need be recalled, whereas biology students enjoy learning about the diversity of the living world but may be wary of generalizing observations into quantitative models. This cultural divide is addressed in the report, which states, “These problems will not be solved by making longer lists of courses from multiple departments and congratulating ourselves for our multi-disciplinarity. They demand a thoughtful approach to integrating biological physics into the fabric of physics education, and science education more generally, in ways that truly add value for all students.”

Other aspects of education are also addressed, and the reader can see the report for a discussion of the distribution of PhD degrees over the past 20 years among the various subfields of physics; doctoral degrees in biological physics (as a subfield of physics) compared with biophysics (as a subfield of the biological sciences); specific recommendations about improving education in statistical physics, dynamical systems, and modern optics or imaging; and steps to take to improve postdoctoral training. The report also focused on the engagement of undergraduate students in research, a topic that has been the subject of several articles in *The Biophysicist* (https://meridian.allenpress.com/the-biophysicist/article/2/1/1/447346/Project-Symphony-A-Biophysics-Research-Experience; https://meridian.allenpress.com/the-biophysicist/article/2/2/28/469195/Adapting-Undergraduate-Research-to-Remote-Work-to; https://meridian.allenpress.com/the-biophysicist/article/1/2/1/431467/Reflections-on-Undergraduate-Research-Mentoring). The committee noted that funding for undergraduate curricular learning and funding for undergraduate research should be correlated and that “new programs are needed for more effective *integration* of teaching and research.”

A prospective, bright note is sounded by the report with respect to the “mix” of students who may study biophysics in the future: “The unique appeal of combining the physicist’s style of inquiry with the striking qualitative phenomena of life confers a special opportunity to attract a broader and more diverse community of students.”