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RE: Equitable and Effective Teaching in Undergraduate STEM Education: A Framework for Institutions, Educators and Disciplines

The American Society for Biochemistry and Molecular Biology is an international nonprofit scientific and educational organization that represents more than 12,000 students, researchers, educators and industry professionals. The ASBMB strongly advocates for strengthening the science, technology, engineering and mathematics (STEM) workforce, supporting sustainable funding for the American research enterprise, ensuring diversity, equity and inclusion in STEM, and addressing emerging issues in the scientific enterprise.

The ASBMB appreciates the opportunity to provide input on the National Academies of Sciences, Engineering, and Medicine's (NASEM) [draft](#) report. Equitable and effective teaching strategies are vital to American higher education and a thriving scientific enterprise.

To make the framework effective, the ASBMB recommends that NASEM expand and enhance the content regarding three key aspects in the final report: (1) direct administrators to prioritize and reward teaching, including in tenure and promotion decisions and in the status of non-tenure-track faculty; (2) advise federal agencies to incentivize effective teaching strategies by making their adoption an integral requirement of any and all programs targeting higher education; and (3) expand the principles in the report to include accessibility.

The society has recommendations pertaining to each principle of the framework along with five additional recommendations:

Principle 1: Students need opportunities to actively engage in disciplinary learning.

As stated in the draft report, active learning has a positive effect on student learning. It is important that all students can access these strategies. The ASBMB encourages NASEM to elaborate on how active learning techniques be adopted by all institutional classifications. Additionally, engaging in [high-impact educational practices](#) is key to active learning, especially for students from historically marginalized backgrounds. Such practices encompass but are not limited to [undergraduate research \[including course-based undergraduate research experiences \(CUREs\)\] and service learning](#), which foster a high attachment to the sciences. The society suggests that high-impact educational practices be included in principle 1. Furthermore, NASEM should ensure that its final report explicitly emphasizes the continued need for the acquisition of foundational subject knowledge throughout the active learning process.

Principle 2: Connecting to and leveraging students' diverse interests and goals, prior knowledge and experiences enhance learning.

The ASBMB agrees that connecting course content with students' interests is important to enhance learning. The society suggests that NASEM consider non-STEM interests, values, and personal and career goals within this principle. Non-STEM interests would thus connect students' long-term goals and community attachments and values with students' studies, as well as integrating the knowledge students gain through their STEM curricula into processes of overall intellectual growth and life-long learning. Success both within and beyond college is enhanced when students make informed choices regarding their future careers and are equipped with the well-rounded skillset — e.g. communication, critical thinking, teamwork, and cultural sensitivity — needed to thrive in today's globalized environment.

Principle 3: STEM learning involves affective and social dimensions.

The ASBMB encourages NASEM to expand this principle and to provide more examples of strategies to incorporate affective and social dimensions into undergraduate curricula.

Principle 4: Identity and sense of belonging shape STEM learning.

The ASBMB recommends that NASEM include topics such as stereotype threat, the history of science, and metacognition into principle 4. All of these ideas are vital to students' understanding of their own place within the scientific community and help them to find strategies to overcome barriers. Faculty, staff and administrators also need clearer understanding of these topics to support their students and to create inclusive learning environments that promote a sense of belonging.

Principle 5: Multiple forms of data can provide evidence to inform improvement.

The ASBMB greatly appreciates the inclusion of data into the report as data collection is important to achieving equity. The society strongly suggests that NASEM include data on providing adequate funding and other support for high-impact, active-learning practices, including students' engagement in research. Importantly, NASEM should consider the benefits of providing students with multidimensional feedback about their progress in learning concepts and skills — beyond one-dimensional metrics such as letter grades and grade-point averages. It is also critical to recognize that thoughtful data collection, analysis and response require resources and coordinated commitments at all levels. For instance, broadening an instructor's awareness of students' backgrounds is, by itself, insufficient to concretely support the learning of diverse students; such information must be coupled with effective solutions and the resources for implementation, within the classroom and beyond.

Principle 6: Flexibility and responsiveness to situational contextual factors are important.

To ensure maximum flexibility for students, the ASBMB suggests that NASEM include recommendations for developing flexible course scheduling and equitable requirements for students, as well as policies to ease transferring from community colleges to four-year institutions in the report. Moreover, when creating transfer/articulation policies, NASEM should urge collaboration between community colleges and four-year institutions. The final report also should address the particular challenges faced by nontraditional students (including those older than usual college age or those changing professions, etc.) and by those who change majors, experience academic setbacks due to life

events, or otherwise need catch-up mechanisms. Ideally, the report would also contain examples of support mechanisms for these students

Principle 7: Intentionality and transparency support more equitable opportunities.

The ASBMB commends NASEM for including a principle on transparency practices for the classroom. However, the society encourages NASEM to consider transparency not only in the classroom but at multiple levels in the educational enterprise from hiring and promotion practices, resources available for faculty such as [Centers for the Integration of Research, Teaching and Learning](#), and resources for scientists/administrators who are not in the education space.

Additional Recommendations:

Recommendation 1: Host listening sessions with undergraduate and graduate students.

While the society appreciates the opportunity to respond to the call to input, we acknowledge that the voices of the students who will be affected by the framework are critical to its development. To strengthen the framework, the society strongly suggests that NASEM hold listening sessions with coalitions, student groups, and individuals matriculating in undergraduate and graduate degree programs.

Recommendation 2: Include an additional principle on barriers.

The society strongly recommends that the report include a principle that addresses barriers to higher education, specifically in STEM, such as financial or disability-related barriers.

Recommendation 3: Regional/institutional accrediting association

Accrediting associations and bodies are instrumental in providing standards for the higher education system. The society strongly suggests that NASEM task accrediting associations and bodies with updating standards to include effective, equitable teaching practices (with the CUREs model as one example), as well as to provide professional development for educators.

Recommendation 4: Federal agencies

Federal agencies — such as the National Science Foundation, the National Institutes of Health, and the Department of Education — that fund training programs should require the implementation of equitable and effective teaching practices. The ASBMB recommends NASEM collaborate with federal agencies to help institutions incorporate successful pedagogies and curricula, including funding mechanisms for low-resourced institutions and minority-serving institutions to implement elements of the framework. Additionally, NASEM should encourage federal agencies to establish more diversity-related funding opportunities.

Recommendation 5: Institutional/Departmental Commitment

Institutional and departmental support are critical to effectively change the current educational enterprise. As discussed above, the ASBMB recommends that NASEM work with institutions to develop frameworks for restructuring hiring, tenure and promotion processes together with reward systems for all faculty to prioritize and reward the implementation of equitable and effective teaching methods.