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Discussion Forum

Response to Review of Fundamental Laboratory Approaches for Biochemistry and Biotechnology

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John Markwell presented a comprehensive review [1] of the second edition of our laboratory manual, *Fundamental Laboratory Approaches for Biochemistry and Biotechnology*, which we fondly refer to as FLABBe2 ([2]. Markwell's review was fair and provided valuable information for us to consider in future editions. It should be noted that the experiments in FLABBe2 are designed for laboratories running 2 days per week in one semester, or one laboratory per week for a year, and includes suggestions for additional, more independent student experimentation.

Importantly, he moves beyond reviewing the manual, and poses general questions about the use and utility of laboratory manuals. Similar inquiry was part of the discussion at the recent ASBMB education conference held in August 2009 at Colorado College, *Student-Centered Education in Molecular Life Sciences.* The session, chaired by Ben Caldwell and Ann Aguanno presented an opportunity for faculty to develop curricula and share laboratory exercises. One of the features was a skills matrix, which could be used to evaluate and assess curricula. The original matrix was published in a 2001 BAMBEd article, which reviewed the skills and techniques suggested for a biochemistry undergraduate curriculum [3]. That article also contained a comparison of several laboratory manuals, so that readers could compare the type of skills and techniques used in each manual. We would like to point out that the goal of FLABBe2 is not simply to teach techniques, but to develop in the student the ability to ask questions and use some important techniques to answer questions. A constant theme is for the student to better realize the importance of answering the question: How do you know what you measured is what you think you have measured? This requires the use of appropriate positive and negative controls. These are basic skills that underlie all good research.

Discussions at ASBMB laboratory workshops have provided insight into the uses of laboratory manuals. Commercial manuals are useful to users for many reasons. A laboratory manual that includes extensive theory will be an invaluable resource for many years, and many of us probably have copies of our favorite old manuals on our shelves, well worn and thumbed to open to specific table and charts. For new faculty, a laboratory manual provides a set of experiments that have been tested and demonstrated to work in the hands of students. This is an invaluable aid to faculty who will have to start from scratch to prepare classes or design new curricula. On campuses where teaching assistants are the laboratory instructors, the use of a detailed laboratory manual coordinates the sections and provides continuity when several different instructors teach the laboratory course.

There are several biochemistry and molecular biology laboratory manuals on the market, and most are written with slightly different target audiences: some contain background information and selected experiments, while others contain only theory. The focus can range from protein biochemistry to commercial biotechnology. A more recent trend to incorporate research-based laboratory (RBL) experiments is an option in several, including FLABBe2. *BAMBED* also regularly features articles that demonstrate and assess RBL style protocols.

Markwell also noted the use of simple instrumentation required in the laboratory manual. We have found that many undergraduate laboratories do not have sophisticated equipment available, and many colleges still rely on equipment as basic as Spec 20s. Some faculties are wary of having students learn from protocols featuring advanced instrumentation that differs from instrumentation available in their own laboratories. The FLABBe2 manual is designed to allow students to learn the rudimentary aspects of the instrumentation, including the principles that underlie the basic measurements. If students learn the theory and apply it, they should be able to adapt the expertise to more advanced instrumentation. Indeed, more advanced instrumentation is generally used in research laboratories, but often the principles of their operations are occluded from the user.

In summary, we hope that FLABBe2 will serve a population that finds the theory and experiments useful. A continuing discussion in *BAMBED* about laboratory experiments would be useful and interesting.

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