Foreword: Looking Backward and Moving Forward in Undergraduate Life Science Quantitative Education

It is a pleasure to read the contributions in this book, particularly since the importance of mathematics in biology has only slowly been realized over the past several decades by the biological research and education community. When I organized a Quantitative Sciences Curriculum for the Life Sciences Students workshop in 1992 for leading practitioners of mathematical biology, there were few mathematics courses designed specifically for life science students and many bench biologists were unconvinced of a need for quantitative education. Although I did not know it at the time, several of the issues addressed in the 1992 and later workshops I organized had been the subject of the Cullowhee Conference on Training in Biomathematics held in 1961 at Western Carolina University in Cullowhee, North Carolina, and attended by many leading mathematical biologists. Issues addressed at the Cullowhee Conference still reverberate today, including: "To what extent should mathematical courses given to biologists be different from those given to mathematicians?" (H.D. Landahl) and "Traditional biology courses lay far too much emphasis on the direct acquisition of information. Insufficient attention is given to the interpretation of facts or to the drawing of conclusions from observation and experience." (J. G. Skellam).

So have we learned anything in the fifty years since the Cullowhee Conference? This volume is a testament to a resounding YES! Many model programs have been developed, curricular material has been assembled, biologists are more attuned to the utility of quantitative approaches, and education research provides guidance on what works – learning not training, research participation not canned labs, active learning and peer collaboration not listening to lectures. We have moved beyond anecdotes to the science of science education. The diversity of models and processes described in this book provides evidence of the need for alternative approaches to assist our students to become "fearless biologists" in utilizing quantitative concepts and skills so that they can not only assimilate, but also participate in modern biology.

Integrating quantitative perspectives throughout the undergraduate life science curriculum, a goal emphasized in the 1992 Workshop, is still a work in progress. The host of reports since that time, including *BIO2010* and *Vision and Change in Undergraduate Biology Education*, all emphasize the benefits of an integrative, multi-disciplinary view of modern biology with quantitative concepts and skills being a central component. This book provides evidence that there is institutional variation in successful methods to ensure that exposure to quantitative topics for life science students is not isolated in a few mathematics and statistics courses but are an integral part of the modern biologists' tool-box. The developers of the examples presented here are to be lauded for their willingness to take an integrative view of undergraduate biology education. The funding agencies that assisted them are to be encouraged by the progress to date and urged to continue to support successful ventures in quantitative education for all our students.

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Foreword: An Invitation to BIO SIGMAA

Although the history of mathematics and computation in biology began a long time ago, the history of this volume begins with the formation of BIO SIGMAA. In January of 2006, Carl Cowan and Michael Pearson spoke with me about the SIGMAAs of the MAA at the Joint Mathematics Meetings in San Antonio. Carl was President of the MAA at the time and saw mathematical biology as an important growing area in mathematics and one that might benefit from the SIGMAA program of the MAA. I had helped run several successful MAA PREP workshops related to mathematical and computational biology and I suppose that put me on Carl's list. I am also tall, which makes me easy to track down in a crowded room.

Over the next few days, we spent time talking with other people we thought might be interested in being a part of the SIGMAA. There was a great deal of support from people both more and less experienced than I. Somehow I found myself organizing the effort, but I was really just collating the ideas of others. I finished the first draft of the charter in April 2006 and after feedback, it was completed by July. In August 2006, BIO SIGMAA became the tenth SIGMAA.

Since biology can hardly be called a single field of study, mathematical and computational biology can be no less diverse. It was important from the beginning to be as inclusive as possible, welcoming all areas of biology and all approaches to understanding them. At the time the SIGMAA formed, there were several organizations promoting research in mathematical and computational biology, but the connection to educational practices and undergraduate research needed a broader platform and a bigger voice. BIO SIGMAA was created to strengthen the ties between research and education and to provide a venue for sharing ideas.

From 2006 to now, many people have put in a great deal of effort into BIO SIGMAA and it has grown in both numbers and maturity. This volume gives readers a taste of current educational practices in mathematical and computational biology. It represents approaches taken or proposed in different areas of biology, different approaches to the study of biology, and the relationship of these practices with different aspects of education.

There are many other ideas that did not fit into this volume and I feel sure new ideas will be motivated by those that did. I encourage everyone to share those ideas at an upcoming BIO SIGMAA event.

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