Biology by Numbers: An Encouragement to Quantitative Thinking

R. F. Burton, 1998
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BIOLOGY and the life sciences in general are becomingly increasingly focused on measurement and quantification: how many; how long; what proportion; what effect? Managers are also placing increasing pressure on scientists to produce bottom line figures that quantify nature in order to make effective management decisions. However, many biology students and graduates are not from a mathematical or quantitative background, and find it difficult making the transition to the quantitative thinking necessary to provide such information.

As one of the "number shy" who Richard Burton addresses in his book *Biology by Numbers*, I opened the front cover hoping for numerical enlightenment. Unfortunately by the time I read the final chapter, the author, who clearly knows his stuff, had failed to impart his wisdom to me on a level I could grasp.

Biology by Numbers is written primarily for beginning undergraduates as an introduction to quantitative biology. As the author states, it is not a "how-to" mathematics book, and he suggests the less mathematically inclined turn to other sources if required. Perhaps that is what I should have done prior to undertaking this book, although if I had, I probably would not have needed to read *Biology by Numbers*?

The book is split into 17 chapters which appear to follow no particular mathematical or biological sequence. Topics include energy metabolism, proportions, percentages and ratios, trophic pyramids, sodium in plants and animals, logarithms and exponential relationships. I found the second chapter of the book to be of most value. It discussed some of the obstacles to quantitative thinking, addressed units of measurement and conversion factors, explained how to check formulae for consistency of units, how to get a feeling for magnitudes, and the use of approximate arithmetic.

The book provides numerous examples from physiology, zoology and plant ecology, covering a diverse range of topics from buoyancy in fish to photosynthesis to the number and size of cells in the human body. Questions are posed to the reader after providing an example of a concept, but answers to these questions are not given. While I understand the author's intention of not providing exact answers so teachers may use the book as a vehicle to test student's comprehension, I was frustrated at not being able to use this as a test myself. I felt that the provision of answers as an appendix would have added to the book's value and widened the appeal of the target audience.

One of the most important messages of the book is that while we can measure and quantify nature, there is no such thing as a "standard" eucalypt tree or a "standard" rock wallaby. Nature is inherently variable and the data obtained are often uncertain, hence the answers we get from our calculations may not be as precise as we would expect. The author advocates the use of "approximate arithmetic" and "back of envelope" calculations when rough estimates are all that are needed or where you have been unforeseeably separated from your calculator.

While the biological aspects of the book were interesting, I felt that the way mathematical concepts were presented was above the level of the intended reader (the beginning undergraduate student and the number shy). At times the author's writing style was fanciful and detracted from his ability to impart his obviously substantial knowledge to the uninitiated. For this reason, I would not recommend *Biology by Numbers* as a first year textbook. Rather the book may be of use to second or third year biology students. As far as the postgraduate "number shy", an introductory mathematics text or statistics book may be of more benefit.

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