

General Introduction

The mathematics curriculum as we know it grew out of the mathematical needs of physical science. We start with a full course in calculus, which requires three semesters at most institutions. This is followed by courses in linear algebra, differential equations, and calculus-based probability and statistics in some order. The latter subjects are the ones with the broadest applications in biology, along with several discrete topics that do not occupy a place in the physics-based mathematics curriculum. Biological applications in these courses have been rare until recently, but many authors are now incorporating biological examples. There are some books in these traditional areas for life science students, but there is no consensus mathematics curriculum for life science.

The standard biology curriculum includes very little mathematics, in spite of the development, beginning in the 1920s, of several important mathematical models for biology. The typical curriculum for biology majors includes just one course in calculus and one in non-calculus-based statistics, and anything beyond two courses is rare.

The result of the gap between the extensive mathematics background that is beneficial to biologists and the minimal mathematics background biology students acquire in their courses is an undergraduate education in biology with very little quantitative content. Mathematics could be incorporated into biology courses such as genetics and ecology, but this is difficult unless the biologist who teaches the course can count on students with the necessary mathematics background.

The obvious answer, from a mathematician's point of view, is for biology students to take the full calculus sequence followed by courses in linear algebra, differential equations, and probability with statistics. There are two problems with this answer. First, the courses contain almost no biology, being designed for the physical or social sciences. This could be fixed without a major curriculum change. More serious is the problem of fitting these courses into a biology student's program. As it is, all biology students are essentially double majors, with enough courses in mathematics, physics, and chemistry to encompass a major in general science, along with the major in biology. The addition of four more mathematics courses is impractical, even for biology students who have the interest and aptitude.

In this volume, authors from a variety of institutions address some of the problems involved in reforming mathematics curricula for biology students. The problems are sorted into three themes. We begin by examining curriculum Models. It is straightforward for mathematicians to generate curriculum ideas for the training of mathematicians, but it is more difficult to generate curriculum ideas for the training of biologists. A number of curriculum models have been introduced at various institutions, and a selection of them comprise the Models section. The second theme is Processes. Suppose we have created an outstanding course that clearly meets the needs of its students. This course amounts to nothing unless it is institutionalized in both the biology department, as a curricular requirement, and in the mathematics department, as a course that will be staffed even after the creator of the course is no longer on the faculty. The final theme is Directions. Here we look to the future, with each paper laying out a case for pedagogical developments that the authors would like to see.

There is some overlap between the Models and Processes themes. All of the Processes papers refer to some model, although its role is sometimes peripheral. Many of the Models papers mention process issues as well. Some contributors, such as Kubatko and Nance of Ohio State University, have pieces in both parts. Other papers were placed in whichever part seemed to be the better fit, but for some this was almost arbitrary. The papers by MacLean, Lee and Boyd, and Joplin et al combine almost equal doses of model and process; the first two appear in the Processes part and the last one in the Models part.