

## Chapter 5

# Strategies for Managing the Mastery-Based Individualized Laboratory<sup>1</sup>

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William J. (Bill) Mullin has been at the University of New Brunswick since 1974 where he is currently a Senior Teaching Associate in the Biology Department. He and John Tidswell began individualizing biology laboratories in 1978, and currently use this strategy in a Biochemistry, Molecular Biology, and Physiology Laboratory for second-year undergraduates. Bill has been actively involved in the National Science Teachers Association, National Association of Biology Teachers, and the International Society for Exploring Teaching Alternatives (of which he is President-elect). He is also Director of a 3-year Science Teacher Refresher Program designed to update all Science teachers in the Province of New Brunswick.

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1. This workshop used an individualized case study method to help participants see how to apply the management strategies that were presented. The goal was for participants to leave the workshop having developed strategies to individualize one of their laboratory courses (or with concrete ideas to more efficiently manage an individualized laboratory). Contact the authors for further advice and suggestions.

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**Reprinted from:** Mullin, W. J., and J. Tidswell. 1990. Strategies for managing the mastery-based individualized laboratory. Pages 73-75, in *Tested studies for laboratory teaching*. Volume 11. (C. A. Goldman, Editor). Proceedings of the Eleventh Workshop/Conference of the Association for Biology Laboratory Education (ABLE), 195 pages.

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Individualization leads to equal or better learning in what students often describe as a more enjoyable atmosphere (Kulik et al., 1979). Learning can be further enhanced if the student is expected to master the content by repeating it until acceptable (Stice, 1975). By enhancing active student participation, a mastery-based individualized laboratory is an ideal opportunity for students to develop decision-making and problem-solving skills.

However, this form of laboratory instruction has enjoyed limited popularity (Jackman, 1982), perhaps because the individualization of large (up to 150) undergraduate laboratories places heavy demands on staff time, facilities, and resources. In addition, student procrastination is a big problem in the traditional "open-ended" individualized laboratory.

In 11 years of experience with individualized laboratory instruction, we have successfully implemented several management strategies which allow all the benefits of individualization and mastery with manageable instructor and technician time, efficient control of facilities and equipment, and motivation for students. The individualized laboratory calls for planning and organization by both students and staff. The students are helped both by the way our courses are designed and by our laboratory management strategies.

There are three key elements in our course design: *instructor-set pacing*, *flow chart preparation*, and *mastery-based grading system*. *Instructor-set pacing* consists of two strategies: a modification of the traditional "open-ended" individualized course to establish "availability windows" (length of time over which each laboratory, project, or piece of equipment is available to students) and an active effort to show students the advantages of "time-budgeting." *Flow chart preparation* requires each student to prepare, in advance, a diagrammatic representation of the procedure or project they will attempt. This activity helps students consolidate information and assign priorities, and reinforces the concept of advance planning. Staff are able to target student-perceived problems and advance-plan laboratory use. This *mastery-based grading system* allows students to receive rapid feedback and also allows student demonstrators to participate in the evaluation and feedback process. All tasks are well-defined by behavioral objectives with specified criteria for mastery.

Efficient laboratory management is accomplished using *equipment and supplies request*, *advance sign-up*, and *shoobox provision* systems. Following instructor evaluation and, if necessary, directed modification, a flow chart is approved and an *equipment and supplies request* sheet is issued. The student details all necessary equipment and supplies on this sheet and gives it to the course technician. The technician will provide these materials at a mutually agreeable future time; this *advance sign-up* being organized by "booking sheets." The advance sign-up ensures that the required laboratory space, major equipment, and supplies are available at the designated time. Supplies indicated on the equipment and supplies request sheet are provided at the laboratory time in a *shoobox*. The student takes these supplies to the laboratory where the equipment is located and

executes the laboratory exercise or project; if successful, the data is analyzed and the results presented; if unsuccessful, the project or exercise may be repeated, after some modifications are suggested, by submitting another equipment and supplies request sheet and by signing up for more laboratory time.

These course management strategies not only permit individualization, but also actively encourage critical thinking, active planning, and decision-making by the student. Successful completion of a particular exercise within a reasonable time is tied directly to two factors under student control: detailed planning of the experimental procedure and accurate forecasting of supply and equipment needs. These both require a critical analysis of the experimental pathway with due regard for potential problems and pitfalls. Helping students cope with the responsibilities of individualized laboratories combined with instructor-set pacing to alleviate procrastination and mastery-based grading system for quick feedback to students all make for a manageable, truly individualized, undergraduate laboratory.

### Literature Cited

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