USE OF CSIP FUNDS IN A COURSE IN MOLECULAR BIOLOGY

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For the past several years, Kalamazoo College has offered a one-quarter course in Molecular Biology. This course is usually taken by six to eight biology or health sciences majors during the Summer Quarter at the end of the junior year. The course has as prerequisites a core course in cellular biology and introductory courses in general and organic chemistry. The objective of the proposal submitted to the National Science Foundation under the College Science Instrumentation Program was to improve the laboratory of the Molecular Biology course.

The course in Molecular Biology uses the textbook Genes II by Benjamin Lewin and has three components. The first is a lecture series that follows the basic organization of the text. Three lectures are given each week, and they attempt to integrate material dealing with both prokaryotic and eukaryotic cells. The second component of the course is a journal club based on readings from the primary literature. The journal club meets once a week for two hours, and each week, all of the students read a short review article related to the lecture material. Most of the review articles have been taken from Trends in Biochemical Sciences or Cell. Two or three journal articles selected by the instructor are then presented by individual students for class discussion. Depending on the enrollment in the course, each student makes two or three presentations during the term.

The third component of the course is the laboratory work. The laboratory is scheduled for one four-hour block each week and is based on the labtext Recombinant DNA Techniques: An Introduction by Raymond L. Rodriguez and Robert C. Tait. This book describes a series of experiments in which 1) plasmid and chromosomal DNAs are isolated from Escherichia coli; 2) the DNAs are digested with several restriction endonucleases; 3) the DNA fragments are joined together by DNA ligase and introduced into E. coli hosts defective in histidine biosynthesis or arabinose utilization; 4) His and Ara transformants are selected and characterized phenotypically; and 5) the recombinant plasmids are isolated and restriction endonuclease maps of the cloned fragments are constructed.

This series of experiments has several features that make it appropriate for an undergraduate laboratory experience: 1) the individual experiments are relatively simple and based on explicit protocols; 2) the experiments form a coordinated sequence with clear stopping points; 3) the project does not require radioisotopes or unusual biohazard facilities; and 4) the project is supported by a fairly detailed text, references, and protocols for additional experiments. The labtext is not perfect, however, and students are provided with separate handouts each week that give specific modifications, where necessary, to fit the particular facilities at Kalamazoo. Students usually work individually on the experiments, and they are expected to write two laboratory reports during the term: the first covers the initial set of experiments, the second the entire project.

Successful completion of this laboratory component requires equipment for the electrophoretic separation and analysis of DNA fragments in agarose gels. Electrophoresis is used at three points in the cloning project: 1) it is necessary for monitoring the digestion of the plasmid and chromosomal DNAs by the restriction endonucleases; 2) it is required for testing the ligation of the
plasmid and chromosomal DNAs by DNA ligase; and 3) it is used for constructing restriction endonuclease maps of the cloned fragments. In each case, the DNA fragments are detected by staining the gels with ethidium bromide and viewing them under ultraviolet light. Prior to submission of the CSIP proposal, the electrophoretic portions of the experiments were carried out with a vertical slab gel system and the gels were analyzed with a hand-held Mineralight. Both of these techniques proved awkward: the gels tended to slide out of the vertical apparatus, and the DNA bands were not clearly visible.

The purpose of the CSIP proposal was thus to improve the laboratory component of the Molecular Biology course by the acquisition of more modern equipment for gel electrophoresis. The grant will allow the purchase of three new constant-current and constant voltage power supplies, and six systems for horizontal gel electrophoresis. In addition, the grant provides for the acquisition of a high-quality UV transilluminator with a maximal output at 300 nm and a Polaroid photographic system. The equipment will be obtained early in 1987 and used for the first time during the Summer Quarter of this year.

With this new equipment, it should be possible for students to complete the experiments in Molecular Biology with greater ease, efficiency, and accuracy. The photographic system will allow them to obtain a permanent record of the results and will improve their analysis of the data. With the new gel systems, it will be possible to accommodate six students in the course if they work individually, or 12 students if they work in pairs. In addition to its use in the Molecular Biology course, the equipment will also be used to set up demonstrations of electrophoresis for the Cellular Biology core course and to enhance the laboratories in upper-level courses in Immunology and Microbiology. The acquisition of this equipment thus should increase student understanding of the basic techniques of Molecular Biology and prepare them to do further work in this area.