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AUTHOR Comte, R. F.; And Others
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ABSTRACT

Reported is the implementation of a science seminar program and an "8 + 2 Program" at Masters School and Hackley School in Tarrytown, New York. Senior students in the seminar program were asked to conduct ecological studies of uninhabited islands in the U.S. Virgin Island chain and studies of the nutrition value of Central American grains. The supplementary "8 + 2 Program" consists of eight hours of instruction and laboratory work on analytical technologies and concepts, with emphases on the use of the Technicon Autoanalyzer system. Two hours of work in medical profiling and environmental sciences are also required in the "8 + 2 Program." A workbook, a programmed text, and two tests on the detection of kidney malfunction and diabetes, respectively, are used. Discussions are included concerning students' application of acquired autoanalysis skills in the "8 + 2 Program" to the science seminar. A training course for teachers' acquaintance with automated techniques is described. The level of student interest and involvement has remained high in such curriculum changes. (CC)

# THE INTRODUCTION OF AUTOMATED CHEMISTRY AT THE COMMUNITY HIGH SCHOOL LEVEL

by

R. F. Comte, G. Carl Buessow
and James F. Melville

It is felt by many that high school students must wait until they have entered college to be exposed to modern biochemical technologies and concepts. One reason for this delay is easy to understand - colleges and universities are geared to offer students these techniques. As a result, the academic growth of many a high school student is needlessly delayed until he reaches college.

At Hackley School in Tarrytown, New York we feel that high school seniors in particular should be exposed to biochemical technologies and up-to-date equipment, as part of their regular curriculum, in order to bridge the gap between high school and college. In our view, seniors planning to pursue careers in the chemical, biochemical, biological and medical fields should be aware of these modern techniques. It is our feeling that they are academically capable of using these procedures.

Hackley and Masters schools have instituted a Science Seminar Program for our seniors which allow them to pursue a project of their own choosing. One project launched in 1970, was an ecological study of uninhabited islands in the U.S. Virgin Island chain. This project was set up by the school in the Virgin Islands and the Ecological Research Station on St. John.

R. F. Comte, Director Special Science Projects, Hackley School, Tarrytown, N.Y., G. Carl Buessow, Assistant Head Master, Hackley School and J. F. Melville, Jr., Dean of Academic Affairs, Mercy College, Dobbs Ferry, N.Y.

It was felt by the Ecological Research people that this project had excellent merit, and so starting in March the students went to this island to spend a week doing ecological studies. This particular project was written up in the National Geographic School Bulletin, September 1971.

Several students of the Science Seminar, as part of their independent study, decided to investigate the nutritional value of various grains grown in Central American countries. A proposal for research in this area was accepted by the U.S. International Biological Program. Since the manual techniques required to analyze the grain are very time consuming and project time available to the students is limited, the school turned to automation to enable the students to perform the large numbers of analyses required to develop meaningful data.

It was decided therefore that instruction in automated chemistry should be included in the curriculum and in September 1971 we added a new course called the "8 + 2 Program" to meet this need.

The "8 + 2 Program" consists of eight hours of intensive instruction in modern analytical technologies and concepts, with emphasis being placed on automated chemistry using the continuous flow analysis principles of the Technicon AutoAnalyzer system.

Following these eight hours of lecture and demonstrations are two hours, one covering Medical Profiling and the other Environmental Sciences. The students are invited to visit governmental and private agencies where environmental scientists are measuring the degree of pollution in lakes, rivers, streams and in the air we breathe.

Having created the incentive or desire for involvement in the sciences we now showed them they could master the complexities of the modern automated analytical system. By enabling them to master such a system we strengthen self-concept; build their self-regard. Fink in his studies of high school students in California was able to show a direct relationship between self-concept and academic achievement.

The "8 + 2 Program" centers around the basic AutoAnalyzer system - a blend of sophisticated hardware and technology that is fast becoming commonplace in scores of junior colleges and universities, and is the most widely used analytical wet-chemistry system in the world. The system is based upon the "Continuous Flow Concept," an analytical technique in which chemical reactions take place in continuous flowing, air-segmented streams. The streams flow through six separate analytical units or modules, each of which automatically carries out a different analytical function, such as sampling of unknowns and standards; separating by dialysis; heating for color reaction and measuring; and finally recording of the results.

An integral part of the "8 + 2 Program" is a Workbook on Continuous Flow Analysis and a programmed text, designed for this course. Using these books, a student learns the maximum amount of essential technical information in the shortest time possible. Assignments in the programmed instruction book are given out in class and the student is required to read the chapter during the week at his leisure. The workbook is used for taking notes and reinforcing the material covered in the P. I. book.

A general review in class of not more then five minutes is used to clear away any problems that the students may have encountered either in the wording in the programmed book or any material covered during the previous class. In addition to theory, the eight hours also include practical laboratory sessions in which the students are required to make glass connections and fittings, and to connect various parts of the AutoAnalyzer system. Each student is also required to construct a flowcell for the Colorimeter and to assemble the Dialyzer module. After the students master the construction of the system the serious work of running the AutoAnalyzer takes place.

We chose to run two biological tests because the students could easily identify with these procedures. The first test was for glucose a test for the detection of diabetes. The second was Blood Urea Nitrogen, this test detects possible kidney malfunction. Both of these procedures were discussed at length with the students.

Two examples may serve to illustrate how the training acquired in the "8 + 2 Program" is applied in the Hackley-Masters Science Seminar.

In January 1972, Hackley and Masters initiated a mini pre-med tech program for our students. This course was held weekly and each student had an opportunity to make use of the techniques learned in the "8 + 2 Program". As a direct result of this course two students obtained part-time positions in local medical institutions where automated equipment was in use.

Several of the Science Seminar students collected water samples for pollution analysis during their recent field trip to Henley Cay in the U.S. Virgin Islands. Upon their return they were able to apply their previous training in automated chemistry in the "8 + 2 Program" to run nitrate and nitrite analyses on these water samples at the laboratories of the Lower Hudson Valley Environmental Center at Mercy College.

In order to apply the maximum stimulus of the "8 + 2 Program" and gain the maximum benefit from the students "hands-on" participation, a basic AutoAnalyzer system is desirable and the manufacturer will make factory refurbished systems available to schools for teaching purposes at a significant discount. However, a school need not wait until they have acquired a system to begin this program. A special eight hour segment has been designed so that an instructor may teach the principles and concepts of continuous flow analysis without an actual operating system.

How do teachers learn the techniques of the "8 + 2 Program"? We at Hackley have taken advantage of Technicon Corporation's Instructor Training Course, "TEACHING AUTOMATED CONTINUOUS FLOW ANALYSIS".

This course has been designed to provide teachers with a standardized approach to the latest concepts and techniques available for teaching continuous flow analysis. It is of one week's duration and is open to faculty members of teaching institutions.

The course, which makes extensive use of multi-media techniques, has two major functions. The first is to thoroughly ground the participants in the subject matter. The second and equally as important, is to prepare the teachers so that upon returning to their schools, they will be able to readily set up their own projects and experiments and effectively communicate the subject matter to achieve maximum student benefit and interest.

To facilitate the implementation of their programs, teachers receive upon completion of the course a Teacher's Instructional Aids Kit consisting of 35mm slides, overhead transparencies, programmed instruction text, workbook and Instructor's Reference Library.

Lack of student interest in the high school science curriculum is perhaps caused by the students failure to appreciate its relevancy when they are confronted by its subject matter in the classical approach. At Hackley and Masters schools we have high hopes that the new approaches initiated in the Science Seminar and "8 + 2 Program" will turn on the C student and further stimulate the A student. The level of student interest and involvement in these programs has remained high and several seniors have expressed the hope that their successful participation has contributed in a positive way to these curriculum changes.

Whether a student goes on to college or not is only part of the question. High school comes first and if the student is turned off and drops out intellectually then we have not done our job as teachers.