

## STRATEGIES FOR SCIENTIFIC LITERACY IN UNDERGRADUATE EDUCATION FOR NON-SCIENCE MAJORS<sup>1</sup>

JOY LINDBECK, Department of Education, University of Akron, Akron, OH 44325  
 ROGER KELLER, Department of Biology, University of Akron, Akron, OH 44325

*Abstract.* Senior non-science major students were surveyed in order to assess the effectiveness of the undergraduate natural science (N. S.) requirement at an urban midwestern university. The most frequently scheduled course was N. S. Biology (30%) followed by N. S. Geology (26%), N. S. Physics (26%) and N. S. Chemistry (18%). Over 40% of the respondents indicated that after N. S. Biology or Geology, they had a better understanding of scientific developments as reported in newspapers, television and magazines. Only 25% indicated increased understanding after N. S. Physics or Chemistry. Interest developed in a N. S. course resulted in 6% or less of the students taking another science course after completing the N. S. requirement. There is apparently a need to develop greater interest in the science courses offered for non-science majors to provide a background for scientific literacy.

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Most college and university undergraduate programs require a core of science courses to provide a basis for scientific literacy for those students not enrolled in science and engineering fields (Dressel 1971). The undergraduate sci-

major. At the University of Akron, Natural Science Physics and Natural Science Chemistry (N. S.=Natural Science) were televised presentations. To determine the effectiveness of the program and to explore reactions to alter-

TABLE 1  
*Enrollment in natural science courses, level of course difficulty and attainment of a better understanding in each field of the scientific development as reported in the newspapers, television and magazines.*

	Enrollment		Median Difficulty Level	% Attainment of Better Understanding	
	Totals*	%		Yes	No
Biology	157	30	1.99	43	57
Chemistry	96	18	2.52	26	74
Geology	136	26	2.36	42	58
Physics	135	26	2.06	24	76

\*Total number=524.

ence requirement at a midwestern urban university is frequently met by scheduling 3 of the 4 natural science courses. In the early 1970's, approximately 1,500 students a quarter selected terminal one-quarter courses that could not be used to satisfy requirements for a department

native programs, the senior seminar students in spring quarter and in both summer sessions of 1972 were surveyed by a questionnaire. Of the 312 questionnaires returned, only 201 questionnaires indicated that one or more natural science courses had been taken. Therefore, our total sample consisted of the 201 questionnaires.

As shown in table 1, the most fre-

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quently scheduled natural science course was N. S. Biology (30%, n=157) followed by N. S. Geology (26%, n=136), N. S. Physics (26%, n=135), and N. S. Chemistry (18%, n=96). Students scheduled a diversity of natural science courses.

The ratings of the difficulty level of the natural science courses are presented in table 1. To facilitate the interpretation of central tendency for the difficulty level of the natural science courses, numerical values were assigned: Too Difficult=3, About Right=2, and Too Easy=1. The N. S. Chemistry (2.52) was rated between too difficult and about right. The rating of About Right was indicated by the median ratings for N. S. Biology (1.99), N. S. Geology (2.36), and N. S. Physics (2.06).

In order to assess whether or not there had been an increase in the students' understanding for the scientific developments reported in the newspapers, television, and magazines in the field of the natural science course taken, the students' own judgments were requested. As shown in table 1, over 40% of the respondents indicated that they had a better understanding after N. S. Biology (43%) and N. S. Geology (42%), and over 20% of the respondents indicated that they had a better understanding after N. S. Physics (24%) and N. S. Chemistry (26%). The natural science courses appeared to be helping only 25% to 50% of the students to better understand scientific discussions that occurred in the newspapers or on television.

The interest developed by a natural science course resulted in a small percentage of students taking another science course in that field with a range extending from 6% in N. S. Biology to 2% in N. S. Chemistry (table 2). A higher percentage of respondents indicated that if personal scheduling had permitted the taking of another course, they would have done so with a range extending from 30% in N. S. Biology to 13% in N. S. Physics. The majority of students did not find the courses sufficiently interesting to go on in the same subject area.

Suggestions to improve the televised natural science courses (as shown in table 3) were live lectures with smaller

TABLE 2

*Percent enrollment of natural science studies in another science course completed in the same field and preferred for scheduling in the same field if personal scheduling permitted.*

	% Enrollment Courses Completed		% Enrollment Preferred For Scheduling	
	Yes	No	Yes	No
Biology	6	94	30	70
Chemistry	2	98	14	86
Geology	3	97	17	83
Physics	4	96	13	87

sections (153 responses) followed by lab programs and/or field trips (81 responses), small discussion groups (73 responses), and more demonstrations (57 responses). In mode of presentation, the majority of students preferred live lecture with smaller sections, and almost half indicated the desirability of laboratory programs and/or field trips.

TABLE 3

*Suggestions for improvement of the televised natural science courses.*

Suggestion	Frequency
Live lecture with small sect.	153
Lab program and/or field trip	81
Have small discussion groups	73
More demonstrations	57
Improve monitoring	21
Color T.V.	19
Additional topics	11
Deletion of topics	6
No improvements	3

The preference of scheduling the televised natural science courses, courses in the science department, or a mixture of televised natural science courses and courses in the science departments was divided as shown in table 4. Some 34% indicated preference for televised natural science courses, 41% indicated courses in the science departments, and 25% indicated a combination of both.

All of the data pointed to the need of a greater diversity in science offerings for the non-science majors to provide a background for scientific literacy. There is no one best way to accommodate the

heterogeneous scientific backgrounds and interests of students. Students do enjoy interaction and laboratory participation. Programs that include these aspects could be developed with or without some television programming.

TABLE 4

*Desirability of scheduling 3 science courses in the science department, 3 televised natural science courses or a combination.*

	Respondents	
	No.	%
Televised Natural Science Course	29	34
Course in Science Dept.	35	41
Combinations of Both	22	25
Total	86	100

The natural science courses in biology and geology accordingly were revised to offer learning options to the students. At the Learning Resource Center, students can view tapes, slides, and/or demonstrations and laboratory exercises. Students complete units and tests to accumulate total point scores for the grade attainment desired. The program is self-paced to enable students to complete the course according to preferred scheduling of hours in the Learning Resource Center. Graduate teaching assistants are available as needed during the daily period that the Learning Resource Center is open. The natural science course in chemistry is presented as lecture only and in physics, it is presented as lecture with some taped television lectures.

Two science departments responded to the expressed interest of the non-science majors for a diversity of science offering. The Physics Department introduced 5 courses: Descriptive Astronomy; Music, Sound, and Physics; Light, Colors, Cameras, and Perception; Properties of Light Laboratory; and Physics, Energy and Man. The Geology Department had introduced Earth Science in 1970 and introduced Geology and the Environment in the fall of 1972. The non-science majors' enrollment in these new courses not open to the science majors rose sharply from the fall of 1972 to the fall of 1976 for the Department of Geol-

ogy and from the fall of 1972 to the fall of 1977 for the Department of Physics (figs. 1 and 2). In contrast, there was a sharp decline over the same time period for the Natural Science Physics enrollment and the Natural Science Geology enrollment.

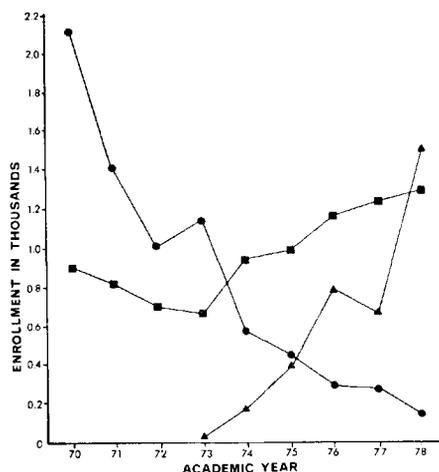


FIGURE 1. ■ Science majors enrollment. ▲ Non-science majors enrollment. ● Natural Science Physics enrollment.

In 1975 the Biology Department introduced the course Ecology and Biological Resources to satisfy the needs of the non-major in the area of ecology. The Biology Department in the fall of 1969, however, had an array of courses not available for credit for the science major but available to the non-science major. These courses included Microbiology, Nature Study, Anatomy and

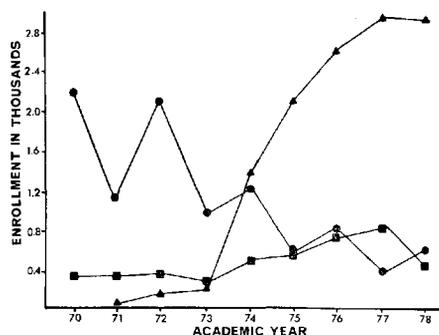


FIGURE 2. ■ Science majors enrollment. ▲ Non-science majors enrollment. ● Natural Science Geology enrollment.

Physiology, Introductory Bacteriology, and Introductory Human Physiology. From the fall of 1971, the enrollment in these courses increased sharply, and the enrollment in the Natural Science Biology course decreased (fig. 3).

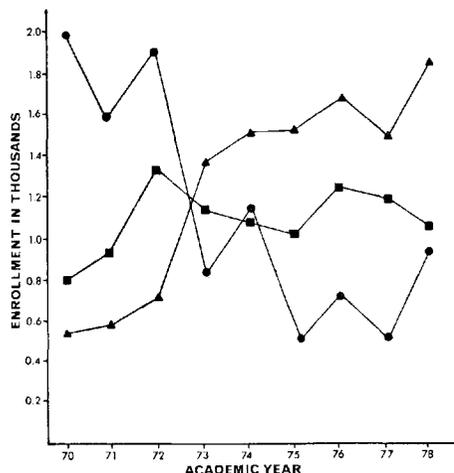


FIGURE 3. ■ Science majors enrollment. ▲ Non-science majors enrollment. ● Natural Science Biology enrollment.

In the fall of 1969, the Chemistry Department offered 5 courses for the non-science major: Introductory Chemistry for Engineers, Inorganic Chemistry, Chemistry, General Inorganic Chemistry for Engineers, and General Chemistry. Enrollment of non-science majors in these courses increased sharply from the fall of 1969 until the fall of 1975. The non-major courses in the Chemistry Department are not chosen as an alternative to the natural science course; rather the student starts a major requiring basic chemistry courses and then may transfer to a non-science major. The drop-off in enrollment in the chemistry non-major courses in 1976-77 reflected the fact that 2 non-major courses were dropped from the chemistry offerings and no courses were added. The natural science enrollment continued to decline from the fall of 1969 to the fall of 1977 (fig. 4).

The pattern of enrollment decrease in the natural science courses was consistent in all science areas. The pattern of enrollment increase in the courses devised for the non-science major was consistent in the areas of biology, geology, and

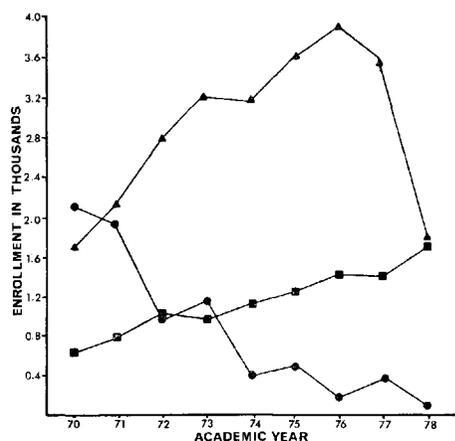


FIGURE 4. ■ Science majors enrollment. ▲ Non-science majors enrollment. ● Natural Science Chemistry enrollment.

physics. Student interest in the various courses developed for the non-science major was shown by a survey of the fall 1976 and spring 1977 graduates (survey data filed in Registrar's office, Univ. of Akron) earning an undergraduate degree, but not majoring in one of the Natural Science Departments or the College of Engineering (table 5). An impressive 70% of the graduates selected natural science courses plus special non-major courses in combination, and over 15% selected just the special non-major science courses. The 10% of the graduates selecting departmental courses and special courses for the non-major suggests that interest to continue in a science field was catalyzed from participation in a non-major science course (table 5).

TABLE 5

*Science course selection by Fall 1976 and Spring 1977 graduates in departments exclusive of the Natural Science Departments and the College of Engineering.*

Science Courses Selected to Fulfill Univ. Sci. Requirements	% Enrollment
Special non-major science courses only	15.5
Natural Science courses only	21.5
Natural Science courses + special non-major science courses in combination	70.1
Departmental courses suitable for science major	16.7
Departmental courses and special courses for the non-major	10.1

The 1972 survey of student evaluation of the offerings for the non-science major was followed by expansion of courses in 2 science departments and revision of the natural science courses. The increasing enrollment trends in the various courses for the non-science major offered in each science department demonstrate student interest in a diversity of course offerings.

We believe the curriculum diversity also provides a background for scientific literacy, a very important goal for undergraduate education.

#### LITERATURE CITED

Dressel, P. L. 1971 pp. 107-110. *In: College and University Curriculum.* McCutchan Publishing Corporation, Berkeley.