

EARTH SCIENCE IN OHIO'S SECONDARY SCHOOLS¹

RAY SKINNER, JR.

College of Education, Ohio University, Athens, Ohio

ABSTRACT

Earth science has been initiated into many high school curricula in New York, New Jersey, and Pennsylvania during the past decade. With the availability of *Earth Science Curriculum Project* materials, many more schools will be including earth science in their science offerings. This study attempts to assess the status of earth science in Ohio by means of a questionnaire survey, made in 1964-65.

A short questionnaire was mailed to each of sixty earth science teachers in 52 high schools in Ohio. Analysis of the 51 completed returns provided the following data: In 1964-65, earth science was taught at all grade levels in some of the high schools. It was offered to students at all ability levels, though some schools offered it only to higher ability students. There was very little opposition to the initiation of earth science in the schools; most teachers felt that earth science should be expanded in their schools. Although the background preparation of the teachers in the earth sciences was not impressive, most of the teachers had substantial backgrounds in the other sciences and were willing to improve their training through attendance at summer institutes in earth science.

STATUS OF EARTH SCIENCE IN THE UNITED STATES

There has been a growing disenchantment with the general science course in the secondary school curriculum. When general science was initiated into the secondary school curriculum, very little science was taught in the junior high and elementary schools. A course introductory to biology, chemistry, and physics was needed when general science was first introduced. Today, elementary and junior high schools have incorporated so much science in their course offerings that the general science course in the secondary schools has become repetitious and obsolete. Some states in the United States have already taken steps to alleviate this problem by introducing earth science into the secondary school curriculum.

Earth science courses have been increasing in the United States (Coash, 1963; Matthews, 1963; Shrum, 1963). In the academic year 1962-63, there were 190,000 students taking earth science (Matthews, 1963). Although this total represented 3,050 schools from all over the country, the students were mostly in New York, Pennsylvania, and New Jersey, where extensive state-wide programs exist.

Earth and space science have become the ninth grade science offering in over 400 secondary schools in Pennsylvania (Kosoloski, 1962). In New York state, 16,223 students were enrolled in earth science at the ninth grade level in 420 schools, and another 17,261 students were enrolled in earth science in grades 10 through 12 (Stone, 1962). Earth science was being taught in 72 schools in New Jersey, most frequently in the ninth grade (Laux, 1962). Hume (1964) has reported similar expansion in the New England secondary schools.

Almost concurrently with this rapid growth of earth science courses in the United States, the American Geological Institute was discussing a proposal to initiate a major, interdisciplinary course-content improvement program. The National Science Foundation funded the proposal early in 1963 and the project was formally called the Earth Science Curriculum Project or ESCP. This project has now prepared and tested a complete set of textual and laboratory materials for a ninth grade earth science course. Houghton Mifflin will publish the first hardcover version of the ESCP materials in the spring of 1967.

At the present time, ESCP is devoting its emphasis to its Teacher Preparation Program. In the January, 1966, ESCP newsletter the headlines read, "Need Foreseen for 12,000 New Earth Science Teachers by 1970." This number was

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based on an estimated enrollment of 1,710,000 ninth graders in earth science by 1970. There were only 7,000 earth science teachers in 1965 and many of these are reported to have an inadequate background for teaching earth science (Boyer and Snyder, 1964; Laux, 1962; Stephenson, 1964).

Some encouraging developments are taking place at the college level. Gates (1960) suggests that geology majors with ability and interest in young people could make excellent earth science teachers in the secondary schools. Hambleton (1964) claims that present secondary school earth science programs are more sophisticated than 75 per cent of the undergraduate college courses, thus placing a responsibility on the geology departments of colleges and universities to graduate greater numbers of more competent people in earth science. More universities might follow the pattern set at Ohio State University, where at least one member of the geology staff teaches methods courses to earth science majors in the College of Education as well as geology courses in the geology department.

Thompson and Shrum (1966) propose several solutions to the urgent problem of increasing the supply of qualified earth science teachers. They recommend that greater opportunities be given for currently certified teachers to receive additional preparation in earth science. Although 1,305 teachers attended summer institutes in earth science in 1966, the great need for more such institutes is evident from the fact that there were at least four applicants for each space available in these institutes. Schools also need to be able to provide graduate credit for these summer institutes, the only level at which a teacher can obtain credit for courses. More colleges and universities must consider offering full earth science programs at both graduate and undergraduate levels; only 65 institutions in the United States now offer a major in earth science (Thompson and Shrum, 1966). Thompson and Shrum conclude that the best long-range solution lies in producing greater numbers of teachers with sound initial preparation in earth science. This involves recruitment of college freshmen who have not been exposed to earth science in high school and who, unaware of the opportunities in this field, have not developed an interest in earth science teaching. Once there are significant numbers of students who have become acquainted with earth science in high school, this recruitment will be greatly facilitated.

In summary, this is the status of earth science in the United States at the present time:

1. There will be an excellent set of materials prepared by ESCP available in the spring of 1967. This includes a textbook, with laboratory investigations incorporated in it, a teacher's guide, a pamphlet series, a film series, and special laboratory equipment.
2. There has been and will continue to be an enrollment explosion in earth science throughout the United States.
3. A critical shortage of adequately prepared earth science teachers exists today and probably will become progressively more acute as demand increases.
4. Some progress is being made in retraining science teachers through NSF summer institutes in earth science, which have doubled in enrollment since 1961.
5. Opportunities for pre-service or undergraduate preparation of earth science teachers are still limited.

STATUS OF EARTH SCIENCE IN OHIO

What has been the growth of earth science courses in Ohio during this rapid national expansion? At what grade level is earth science being offered in Ohio's secondary schools? How was earth science initiated in the schools where it is presently offered? What is the college background and experience of earth science teachers in Ohio?

The answers to these questions and many more were explored by means of a questionnaire survey. Sixty earth science teachers in 52 high schools in Ohio were identified from examination of Principals' Reports (Form 23), which are on file in the offices of the State Department of Education. A short questionnaire was mailed to each of these teachers; 51 of the teachers completed the questionnaires and these were used for analysis.

When the schools in each county offering earth science were listed numerically on a map of Ohio, it became evident that there was some concentration of earth science teachers around large metropolitan areas, with 15 teachers located in Cuyahoga County being the largest group. However, earth science was being offered in at least one school in 22 different counties.

Most of the earth science courses in Ohio were full-year courses, usually taught in grade 9; some, however, were offered in grades 10-12. In at least 10 schools, earth science was taught for one semester; most of these schools were in the Dayton

LOCATION OF EARTH SCIENCE TEACHERS IN OHIO, 1963-64



FIGURE 1.

area. It was possible to estimate the number of students enrolled in earth science in the schools not responding from these schools' principals' reports. Information on the enrollment of earth science students in Ohio for 1963-64 is summarized in table 1.

TABLE 1
1963-64 enrollment of earth science students in Ohio

Full Year			
Grade	Teachers	Sections	Students
8	1	5	150
9	21	61	1595
10-12	16	36	1065
12	3	3	88
Total	41	105	2898
One semester			
10-12	7	14	428
12	3	3	58
Total	10	17	486
Not responding			
	9	19	469
Grand Total	60	141	3853

Teachers were asked to estimate what per cent of their earth science students were college caliber, terminal high school, or potential drop-outs. When the responses were analysed according to grade level, the ninth grade level seemed to be equally divided between classes composed of a normal cross section of ability groups and classes in which over 70 per cent of the students were rated as college caliber. The composition of the earth science classes in the 10-12 grade levels revealed mostly terminal high school students and potential drop-outs. Only six schools offered earth science at the senior level to college-caliber students. Reported grade level and estimated ability of earth science students in Ohio are shown in table 2.

The questionnaire revealed four distinct kinds of earth science offerings: (1) a ninth-grade course for high-ability students, (2) a ninth-grade course for all-ability students, (3) an elective for terminal high school students in grades 10-12, and (4) an elective for college-bound seniors. Most commonly, however, the earth science course was included at the ninth-grade level.

It is possible to chart the growth of earth science in the secondary schools of Ohio by plotting the time of initiation of earth science in each school on a graph. Figure 2 reveals that there were only two teachers offering earth science in 1956. By 1960 there were over 25 and, in 1964, this number had increased to 51 (this number does not include the nine additional non-respondents known to teach earth science).

TABLE 2
College potential of earth science students in Ohio as estimated by their teachers

Teachers of classes	Per cent of students with college potential		
	Fewer than 10%	Between 10% and 70%	More than 70%
With all 9th graders	0	10	11
With 10-12 graders	9	8	3
With all 12th graders	0	1	5
Total	9	19	19

A unique facet of the earth science movement in Ohio was revealed by the teachers' responses to the question, "Who was primarily responsible for initiating earth science in your school?" Twenty of the 51 respondents indicated that they themselves had initiated the earth science courses; in 15 other cases, courses had been initiated by "other teachers." Only 16 courses had been initiated by administrators, supervisors, or school board members.

Twenty-four initiators heard about earth science through college courses; ten of these had participated in and gave credit to National Science Foundation Summer Institutes. Some of these respondents, along with nine other teachers, also marked "professional literature" as a source of their knowledge about the field of

GROWTH OF EARTH SCIENCE IN OHIO

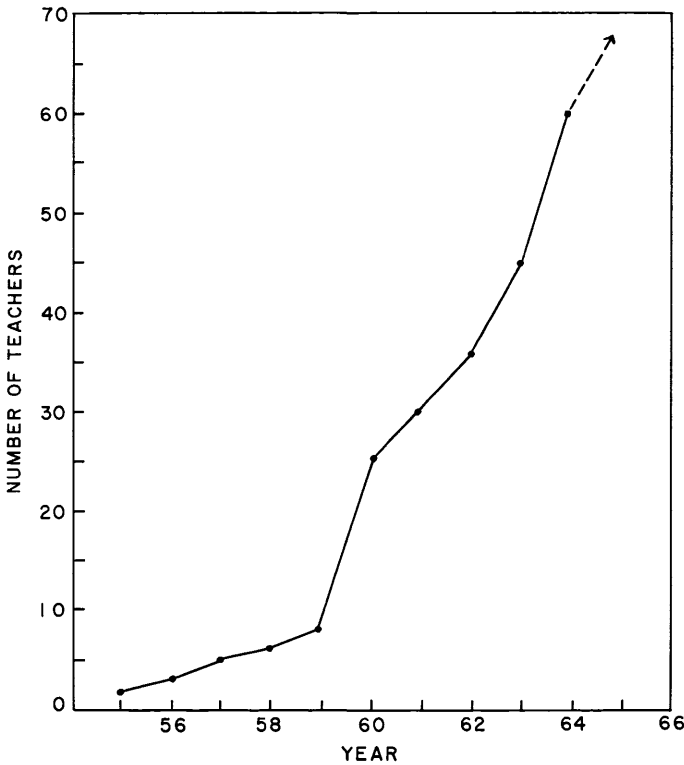


FIGURE 2.

earth science. Only four teachers checked "other high schools." Earth science seems to be accepted remarkably well in Ohio's secondary schools; only ten teachers felt that there had been any opposition to the initiation of earth science in their schools. When asked if the opposition had persisted (at the time of the questionnaire, 1964), only three teachers indicated in the affirmative.

When asked if they were interested in seeing earth science expanded in their schools, 42 of the 51 teachers responded, "Yes," while only nine said, "No." The teachers' affirmative comments stressed offering earth science instead of general science and increasing the number of laboratory periods. Most of the teachers responding negatively indicated that further expansion in earth science was unnecessary because the course was already well-established in their schools.

Responses to another question, "Should earth science be offered in the ninth grade?" reflected the grade level of the students that the teachers were presently teaching. Twenty of 21 ninth-grade teachers felt that earth science should be taught in the ninth grade. Only seven of 30 upper-class teachers believed that earth science should be offered to ninth graders.

Of the 20 teachers who felt earth science should be offered to ninth graders, 19 indicated that it should be offered exclusively to "high ability" students; none of the teachers recommended earth science for "low-ability" students at that level.

The teachers stated that the greatest problems in teaching earth science were lack of teacher preparation and lack of equipment. They indicated that student and administrative interest were of much less concern; six of the teachers wrote in "none" in response to the question about what the greatest problems were.

It is evident that the majority of the earth science teachers in Ohio recognize the weaknesses of their earth science background. Teachers were invited to indicate in which field they felt they needed the most additional training. Their responses showed: 23 in astronomy, 19 in geology, 18 in meteorology, nine in oceanography, six in all areas, and four in other fields. Several teachers listed more than one area.

The training opportunities which were considered to be most beneficial by 31 of the 51 teachers were summer institutes and other college work. Thirty-four of the earth science teachers in Ohio have attended from one to six summer institutes sponsored by the National Science Foundation. Only five teachers listed in-service training as most beneficial and five others mentioned the desirability of more field work.

TRAINING AND EXPERIENCE OF EARTH SCIENCE TEACHERS IN OHIO

About half of the teachers (26) held master's degrees, and the remainder averaged 18 semester hours of graduate credit. An examination of undergraduate majors and minors revealed that almost one-fourth of the teachers majored in an

TABLE 3
*Extent of science background of earth science teachers in Ohio
tabulated by numbers of teachers*

	Number of semester hours of credit			
	0	1-9	10-20	20+
Geology	10	21	9	11
Astronomy	35	13	3	0
Meteorology	40	11	0	0
All earth science courses	6	11	17	17
Chemistry	8	10	19	14
Physics	15	17	17	2
Biology	8	10	17	16
Mathematics	11	16	15	9
Other sciences and mathematics	0	2	2	47

earth science; most of the other teachers indicated a major in biology, physical science, or mathematics. Only eight teachers had majored in an area other than science or mathematics; seven of these held minors in a science.

Analysis of the actual number of semester hours of credit held in the sciences by the teachers revealed that only six of the 51 teachers had not taken at least some courses in the earth sciences; nearly two-thirds of the teachers had taken more than 10 semester hours in these fields. The mean number of semester hours in earth science per teacher was 21. Course credits in all other sciences averaged 45 semester hours per teacher; in mathematics, the average was 11 semester hours per teacher. Ohio earth science teachers were particularly weak in astronomy and meteorology, but their overall background in science seemed rather adequate.

Experience in teaching earth science was naturally limited, but 13 teachers have taught earth science more than four years. Eighteen people were teaching earth science for the first time when this survey was conducted (1964). An examination of the total teaching experience revealed 12 teachers with 16 or more years of experience, 15 with from 6 to 15 years of experience, and 24 with less than six years of teaching experience.

SUMMARY

The status of earth science in Ohio may be summarized as follows:

1. There has been substantial growth of earth science in Ohio, but at the time the survey was made (1964), only 4% of the schools in Ohio offered earth science.
2. In 1964, earth science was taught at all grade levels in the various schools. It was offered to all ability groups, with some preference for the higher ability students in half of the schools offering it in the ninth grade.
3. The impetus for initiation of earth science in the schools seemed to come from science teachers who had attended NSF summer institutes or already had some background in earth science.
4. There was little opposition to the initiation of earth science in the schools. Most teachers felt that earth science should be expanded in their schools.
5. Most Ohio high schools are calling upon teachers of other sciences to teach earth science, which accounts for the substantial background in the sciences generally. The background in the earth sciences, while not impressive, seemed adequate in most cases.
6. The major problem in teaching earth science, as expressed by the teachers, was a lack of teacher background. This feeling of inadequacy may be attributed in part to the fact that training was in several different scientific disciplines, not specifically in earth science.
7. There was an obvious desire for improvement in preparation by the teachers, evidenced by their eager attendance at summer institutes in earth science.

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